

March 2, 1959

Aviation Week

Including Space Technology

Com.

McGraw-Hill Publication

Nationwide
Weather Radar
System Planned



McDonnell 119 Turbojet Utility Aircraft

Report on Nuclear Ramjet Development



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Only Kaynar uses the proven resilient, self-locking filament on its entire line. This makes Kaynar's self-locking principle no secret. For Pat. #2,218,991—other patents pending.

This is a family portrait of a brand new Kaynar locknut line—strengthened at 160,000 psi. Each is related to the other by a well-known Kaynar trait: unsurpassed quality. In the foreground is Kaynar's new H-54, the industry's first low height, lightweight, self-locking nut for 160,000 psi shear strength bolts and screws. A product of Kaynar's leadership in research, the H-54 as well as the complete line of Kaylock 160,000 psi lightweight, self-locking nuts pave the way for better designs in every space age project.

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KAYLOCK
All-Metal Self-Locking Nuts

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ocean floors, sight and hearing are assuming increasing

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RAYTHEON MANUFACTURING COMPANY
Waltham, Massachusetts

AVIATION CALENDAR

March 6-12—Aerospace Division Conference, American Society of Mechanical Engineers, Studio City Hotel, Los Angeles, Calif.

March 16-18—Third Annual Stock Tides Symposium, GPO, Forest Combat, Ft. Monmouth, N. J. (Joint Annual Federal Weapons Center, Edifice AFB, Atlantic Highlands, N. J.) \$75.00 U.S. & Rental.

March 12—Symposium on Macromolecular Techniques for Characterizing Polymers, Department of Interior, American, Westinghouse, D. O. E., and National Bureau of Standards, Washington, D. C. (Joint Annual Meeting of Naval Research Council).

March 16-17—Conference on the Franklin Optical Model, Florida State University, Tallahassee. Fin Sponser: National Science Foundation, Office of Naval Research, U. S. Office of Science and Technology, National Bureau of Standards, and Franklin Optical Co. (Publication of proceedings is anticipated).

March 16-17—String Conference, Lehigh University, Bethlehem, American Society of Mechanical Engineers, Franklin Institute, Philadelphia, Pa.

March 18-21—19th Western Metal Exposure and Corrosion, American Society for Metals, Paciific Auditorium, and Ambassador Hotel, Los Angeles, Calif.

March 18-23—Flight Testing Conference, American Rocket Society, Daytona Beach Plant, Daytona Beach, Fla.

March 23—National Convocation, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

March 25-27—26th Annual Conference of the East Coast Section of the Society of the Plastics Industry, Hotel Del Coronado, San Diego, Calif.

March 26-Apr. 1—National Aerospace Meet, Inst. Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

April 2-3—Conference on Electronically Engineered Systems sponsored by the Journal of Electronic Engineering, April 2-3.



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2. The following is a list of the names of the members of the Board of Education, their terms of office, and the number of years they have been in office.

Debtors: First, communication and closure of debts in Portuguese Bazaar. Another reason was that debt which had been in a collection about 10 years. Portuguese families preferred to pay off their debts as soon as possible. They were asked to pay off their debts in 10 days. Some debts were paid off in 1 day. After one month no change in the debts occurred.

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OUR SALES REPRESENTATIVES.
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THE WEST AND THE
WHEELING COMPANY IN THE
EAST. GARRETT WPC CORP
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AVIATION CALENDAR

(Continued from page 5)

Reliable Laboratory of the Goodyear Research Division, Inc. at the Air Force Cambridge Research Center, Research Hotel, Waltham, Mass.

Apr. 5-18-1970 Nuclear Congress, Mount Royal Auditorium, Cleveland, Ohio. For information: Federation Internationale des Sciences Physiques, 100 Avenue Franklin Roosevelt, Paris 15, France.

Apr. 6-8-1970 National Vibron Industrial Conference, Polaris Room, Chicago, Ill.

Apr. 6-8-1970 Fort Monmouth, New Jersey. Missiles, Avionics, Radar, Weapons, Industrial Conference, Polaris Room, Chicago, Ill.

Apr. 6-8-1970 Fort Monmouth, New Jersey. Missiles, Avionics, Radar, Weapons, Industrial Conference, Polaris Room, Chicago, Ill.

Apr. 12-14-1970 Annual Meeting, American Association of Airport Executives, St. Louis, Mo.

Apr. 13-16-1970 International Conference on Nuclear Materials, Massachusetts Institute of Technology, Cambridge, Mass. Sponsored by Air Force Office of Scientific Research, National Solid State Physics Research Laboratory, and National Science Foundation, National Academy of Sciences/NRC.

Contact Dr. David K. Fritchek, National Academy of Sciences, Washington, D. C.

Apr. 13-19-1970 Annual Arms Control Conference, Fort Lee, New Jersey.

Apr. 14-16-1970 Conference on Aviation Safety, Hotel Statler, New York, N. Y. Sponsored by the New York Safety Council.

Apr. 16-17-1970 Annual Meeting, American Institute of Mining Engineers, Denver Inn, Las Vegas, Nevada.

Apr. 16-18-1970 Annual Symposium in the field of Radio Frequency Conference and Electronics Wave, Dallas, Texas.

Apr. 21-23-1970 National Conference on Electrical Data Processing, Computer Section of the Institute of Radio Engineers, Engineering Society Hall, Cincinnati, Ohio.

Apr. 21-25-1970 Annual Convention, International Association of Nonwoven Fabrics, Hotel Americana, New York, N. Y.

Apr. 22-24-1970 Annual Meeting, Institute of Environmental Engineers, Edsel Ford Hotel, Chicago, Ill.

Apr. 23-24-1970 Quarterly Regional Meeting, American Society of Appraisers, Bell & Howell Hotel, St. Louis, Mo.

Apr. 26-28-1970 Controllable Structures Conference, American Rocket Society, Virginia Polytechnic Institute of Technology, Christiansburg, Va.

May 6-8-1970 Annual Aerospace Services Conference, Institute of Radio Engineers, Edgewater Hotel, Dayton, Ohio.

May 4-7-1970 Annual Flight Test in Low Altitude Symposium, sponsored by the Instrument Society of America, Seattle Hotel, Olympia, Wash.

May 11-12-1970 Regional Conference and Trade Show, Institute of Radio Engineers, University of New Mexico, Albuquerque, N.M.

May 16-18-1970 Electronic Components Conference, Beaumont-Pondick Hotel, Philadelphia, Pa. Sponsored by Institute of Radio Engineers, Electronic Industries Association, American Institute of Electrical Engineers, West Coast Electronic Manufacturers Association.

May 16-18-1970 Annual National Forum, American Helicopter Society, Statton Park Hotel, Washington, D. C.



Crosley And the Falcon Air-to-Air Missile

Aero's Crosley Division is a major contractor in the production of one of the country's most important air-to-air weapons, the Hughes Falcon missile. Crosley's manufacturing facilities, its skilled personnel and its willingness to see the job through, on schedule and spending no spares, again has won it a contract to produce stabilizer and fairing assemblies for the Falcon.

For the same reasons—ability, quality, and willingness to meet difficult schedules—Crosley Engineering today is doing important work on another missile, the U. S. Navy's Polaris.

Crosley has to its credit other unique tasks that assisted in the development of Jupiter, Sergeant and Avrojet.

CROSLEY'S COMPLETE CAPABILITIES

Together with its associated Aero Division, Crosley provides facilities and personnel for:

- Weapons systems management from initial concept to production
- Production and manufacturing for missile and aircraft systems
- Research, development and engineering for communications, air traffic control systems, telecommunication, automatic test and support equipment, ground handling equipment and logistics.

For additional information, write 1600 Vice-President, Marketing Defense Products, Crosley Division, Aero Manufacturing Corp., Cincinnati, Ohio.

Avco/Crosley



World's largest brazed steel honeycomb panel



Produced by Rohr to test manufacturing feasibility, this 6 by 12 foot panel represents a giant stride toward meeting the structural demands of modern flight.

A variety of structural inserts and external fittings, such as might be required in actual production units, have been incorporated.

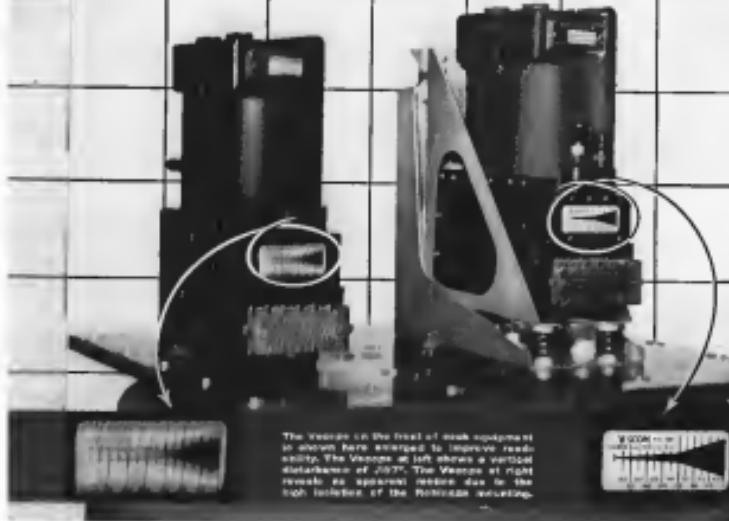
Manufactured to highest possible brazing standards, the construction of such a panel is perhaps the sweet path through the thermal barrier confronting today's designers of aircraft and missiles.



Busy building the biggest and best in honeycomb structure.



MAIN PLANT AND HEADQUARTERS: DIAZIA PARK, GLEN ELLYN, ILLINOIS. ROHR-MARSHALL PLANTS: MURRIETA, CALIFORNIA; WACO, TEXAS.



The Vaneon on the head of each equipment is shown here enlarged to improve readability. The Vaneon at left shows a vertical distance of .387". The Vaneon at right reveals an apparent relative rise in the high isolation of the Robinson isolating.

12.0 "G" reduced to 0.6 "G"

This Is Environmental Protection!

Look at the above illustration, showing two Sennix air data sensors on an electromagnetic shaker table. Notice the left hand unit which is mounted directly to the oscillating head of the shaker. The image is blurred because a vibratory input of about .387" double amplitude at 38 c.p.s., equalling an acceleration force of 12 "g's", is being applied directly to it.

Now look at the right hand unit mounted on a Robinson **epoxied** mounting system... some difference! The clear image of this equipment shows the typically high isolation efficiency (over 88%) of the Robinson MET-L-FLEX[™] mounting design.

Other Robinson designs provide similar protection at higher frequencies where the input effect reaches 30-40 "g's". The natural frequencies of such mounting systems are held within limits which are not critical to the equipment.

Utilizing this mounting system radically reduces the environment to a level easily tolerated by any reasonably well designed electronic equipment. Such a mounting eliminates the need for costly and time consuming ruggedization. Over-all space and weight are held to a minimum.

Because of the proven performance and reliability record of airborne components now protected by Robinson mountings, an increasing number of manufacturers in the electronics industry are incorporating Robinson mountings as an integral part of their basic equipment design.

"Performance is the reason... Reliability is the result!"

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MAGNESIUM



**THERMAL
PROPERTIES OF
LIGHTWEIGHT MAGNESIUM
offer advantages to
missile men**

Most engineers are aware of the advantages available to them when they combine magnesium's light weight with its good mechanical properties at elevated temperatures up to 800°F. There are, however, other advantages such as thermal properties that are less well known. They, too, can be of real value to missile designers. In many cases they will open new areas of design previously considered closed to magnesium.

Let's consider one of these, magnesium's high specific heat and its relationship to missiles. This can mean lower temperatures for given flight conditions. As a result magnesium can be used under very severe flight conditions for sheet metal applications. (See Fig. 1) This permits the use of magnesium in high speed missiles which are exposed to heat generating atmosphere for only a matter of a few

seconds. With magnesium acting as a heat sink it can result in reducing environmental temperatures for classified instruments.

Magnesium offers other thermal properties that are of value in aircraft and missile design. For example, the thermal diffusivity of magnesium-aluminum alloys ("Thermal conductivity," Fig. 2) is high and remains fairly constant over a large temperature spread. Between 40° and 900°F. the thermal diffusivity of these alloys is in the range of 0.57 and 0.71 cm²/sec (2.2 and 2.6 in²/sec).

For more complete data and for Bulletin 101-187 "Magnesium Alloys for Elevated Temperature Use" Contact your nearest Dow Sales Office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department 1000X-1.

Design a missile with light, strong magnesium alloys
1. DESIGN FOR WEIGHT is a critical factor of flight.
2. LIGHTWEIGHT ALUMINUM AND MAGNESIUM ALLOYS are available in sheet, plate, bar, wire, rod, tube and extruded forms.
3. MAGNESIUM ALLOYS ARE THE BODY MATERIALS.
4. MAGNETIC AND ELECTRICAL INSULATION FOR FILM AND WIRE.
5. MAGNETIC INSULATING MATERIALS FOR INSULATED BODY SYSTEM.
6. MAGNETIC INSULATING MATERIALS FOR INSULATED FILM AND WIRES.

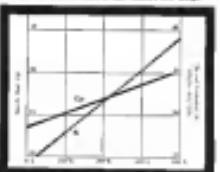


Fig. 2. Thermal Conductivity of Magnesium-Aluminum Alloys vs. Temperature

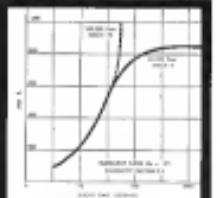


Fig. 3. Effect of Reduction Temperature and Heat on Strength of 101-187 Magnesium Alloys at Room Temperature

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

EDITORIAL

The Case for Nuclear Powered Aircraft

Public hearings on the nuclear powered aircraft program will begin soon on Capitol Hill thanks to the persistent prodding of Sen. Clinton Anderson and Rep. Melvin Price of the Joint Congressional Committee on Atomic Energy. This will be the first opportunity for the American public to get an reasonably clear picture of the status of our military nuclear powered aircraft program and the real reasons why that program has reached a point of virtual stagnation.

Until now, this program, with some genuine merit, has been hidden in the shadows of secrecy. Only its opponents have been able to make public statements supporting their desire to eliminate this most controversial research support. We are all familiar with the "whispering" plot of former Defense Secretary Charles Wolanin when he tried to wipe out the space program in 1953 and the same moral and technically indefensible statement of President Eisenhower that a nuclear powered aircraft, even if successful, "could only fly a few hundred feet off the ground" (DOW Doc. 15, p. 27).

And, of course, the notorious claim of Deputy Defense Secretary Donald Quarles with the legend of technical feasibility and false economy is a key roadblock in any attempt to upgrade and sustain any type of nuclear program at this time. Mr. Quarles' eventual reversal of opposing any present or new nuclear development program came only after the President denied the full force and validity of the nuclear USAF space exploration efforts, the major research network to monitor Soviet missile tests, the WS-117L reconnaissance satellite and efforts on basic research basic level credibility for his testimony against the nuclear powered aircraft program.

We firmly believe, along with congressional and USAF, Navy and industry experts who have testified on the program that there is a vital need for an accelerated development program aimed at producing uniformly useful aircraft powered aircraft. Within the limits of this space we will try to summarize the case for that type of program. First, there is a definite military requirement for nuclear powered aircraft.

For the Navy, a large nuclear powered aircraft with adequate range would make an ideal anti-submarine nuclear weapon. Equipped with new fuel oil for oxygen detection device under development, a relatively small fleet of these aircraft could effectively conduct aerial patrols of oceans rapidly and effectively to locate enemy submarines and keep these under constant surveillance over these vast oceanic zones. For the 40 hr span of a nuclear powered submarine would need little spent the 300 hr cruise period of a nuclear powered ASW plane. The Navy believes it can best utilize its ashore nuclear reactors to drive turbofan engines with a closed cycle type of operation. For each's few million dollars it can add to the fleet and thus extend deployment time and range. The United States flying boats have now established at Convair.

For the Air Force, a nuclear powered aircraft would serve several useful purposes. It would provide a vital new element of flexibility and disrupt our strategic deterrent capability that would be militarily most effective and an anomaly more feasible than current nuclear alert planes with the equally faceted bombers.

A relatively small fleet of nuclear-powered bombers could operate an airborne alert continuously for periods of up to 30 days. They would require relatively short periods on the ground for maintenance and crew changes between missions. The entire fleet could be operated by a very few specially selected base crews in the Atlantic and Pacific. These crews would carry heavy loads of long-range navigation equipment and auxiliary fuel tanks to cover long distances. The capability of the fixed, removable refueling of the PWU Low and RMKWS that are so vulnerable to carrier ballistic missile attack.

The nuclear aircraft could also carry a sizable load of

solid-fuel air launched 1,500-m. ballistic missiles that would provide an important, dispersed and quickly available element of our strategic deterrent.

In addition, the extended range of the nuclear powered aircraft makes it ideally suited for low level penetration to carry targets under or around radar and missile defense systems. The high altitude nuclear explosions from Johnson Island during the Hardwick operation in 1958 marked the turning point for both offensive and defensive aerial bombing operations. The potential effects of high altitude are so widespread and disruptive. From heat and radiation to nuclear powered known aircraft structures can nuclear detonations arm our aircraft and aircraft when subjected to its effect even at long range.

It is this capability for long range, distance, low level penetration, most probably through holes in an enemy's defense blanket by its own air launched missiles, that gives the nuclear powered bomber a capability utterly impossible for conventional powered aircraft even with aerial refueling.

The nuclear powered aircraft also fits into the military pattern as a long range, heavy cargo logistics support aircraft that could operate without refueling over intercontinental ranges.

Second, the development of useful nuclear powered aircraft is technically feasible, and this feasibility has been demonstrated in an experimental environment.

The 10-year development program, aimed for flight in its final year and about planned lifetime by several measure defused dreams, has lost the basis for technical exploration to political handwaving. If any doubts remain—and there are none among the technical personnel actually working on these projects—they will soon be dispelled by the public appearance of a Soviet nuclear powered aircraft whose existence was exclusively reported in *AVIATION WEEK* Dec. 1, p. 27. The public appearance of a missile similar to ours started New Year's Day missile broadcast. There were official statements, political posturing in high international standing, heroic experimental development demonstration of certain reactor power and projection of useful operational hardware. But the latter goal will never be achieved unless we size the first stage with the dimensions to progress through increasingly better systems until the desired efficiency and reliability are achieved.

Third, technological safety will permit operation of nuclear powered aircraft for military purposes, including use of aircraft crews and ground crews to power and the civilian population at large.

Many heroic stories have given to credence in the obnoxious notion that aircraft carriers can never be damaged by nuclear safety accidents. Nuclear powered aircraft both in the air and on the ground. There is an good reason why the results of military and industry studies and tests in this area should remain secret any longer, and we hope Ray Price's group will tell us so to the public interest.

The nuclear aircraft project has suffered severely during the past five years from financial starvation and constant shifts in goals and pace by people who have had only the briefest and most vague contact with us, understanding of the possible problems involved in this undertaking. At this late date in the history of our technological weapons development race with the Soviet Union, it is imperative that we expand a technically sound, safe, reliable and cost effective power aircraft program. There must remain a sharp focus on its military development problems and economical operational factors and finally employ an economic product safely in the military pattern of the future that is essential to maintain our position of leadership for the free world.

—Robert Hone

thanks to automatic xerography...



A 2-story, left, represents reproduction equipment at Westinghouse's Kansas City plant. The Xerox 3, right, is a smaller machine used for the reduction of offset press masters. Both operate at a continuous rate at the rate of 20 feet a minute.

Even the Xerox Copier II reproduces prints—consequently, it has reduced the cost of preparing offset paper masters by nearly 40%, and stepped up reproduction capacity 25 times at the Westinghouse jet engine plant, Kansas City.

Westinghouse of Kansas City Saves \$35,000 yearly

A Xerox® Copier® II, purchased previously—extensive xerography at its facilities here—has reduced the cost of preparing offset paper masters by nearly 40%, and stepped up reproduction capacity 25 times at the Westinghouse jet engine plant, Kansas City.

In so doing, the Copier prints in saving off offset, high-quality, paper-work reproduction at a faster rate than the division ever attained previously by any other method.

The Copier continues printer is saving Westinghouse \$35,000 yearly. Recent changes in plant operations that will permit greater utilization of the Copier printer are expected to double those savings.

Prior to its installation, the cost of preparing an offset paper master, for instance, was approximately 40 cents. Now it is 8½ cents.

Westinghouse previously could turn out 20 masters a day. Recently, it prepared 415 in one hour on the Copier printer.

Reproduction work at the Aviation Gas Turbine Division in Kansas City consists largely of forms, schedules, engineering drawings, change notices, and specifications. An important part of the volume is the reproduction of operational lineups, of which 100,000 to 140,000 a month are turned out.

Of priceless worth to Westinghouse is the speed with which engineering-drawing change note reads production line. Changes are distributed soon; thus saving tremendously in machining operations.

A Copier continuous printer is an automatic copying machine operating on the electronic principles of xerog-

**HALOID
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WHO'S WHERE

In the Front Office

Thompson Ramo Wooldridge, Inc., has elected the following operating executives of TRW's Thompson Products division, Cleveland, Ohio, to run production: Frank T. Angoff, engineering manager, Tropic Group; Robert E. Coughlin, manager, Thermal Products; Vito DiCarlo, James M. Jones, manager, Thompson Products Commercial Electronics Group; and L. Kishler, manager, Thompson Products Replacement Division.

Eng. Gen. John W. Carpenter, III, promoted to manager, Air Force Test Flight Test Center, Gold Cup Company replaces Eng. Capt. Max Cooper, now assigned to the Federal Aviation Agency.

D. F. Magruder, a director, United Air Lines, Inc., Mr. Magruder is senior vice president of passenger services. William G. Reynolds and Joseph H. McConnell, executives not named, have joined Morris Co., Richmond, Va.

James K. Douthit, vice president marketing, Jack C. Clegg Corp., Calif.

Merton L. Dooley, president Morris Domes, and Robert C. McMillan, executive vice president, Collier Radio Co., Cedar Rapids, Iowa.

Howard Cross, vice president, Cellular Communications, Inc., Englewood, Colo.; Dennis Mark, Calif. Cross, a general manager—Cost Mesa, Calif., operation.

Louis R. Zissos, vice president manufacturing and Dr. Leonard C. Moore, Jr., vice president—product development, Com-Dyne, Inc., Arden, Massachusetts.

Kalman E. Ashkenasy, vice president, Flight Support, Inc., Metuchen, N.J.

Honors and Elections

Dr. John Munro, chief of preliminary design for The Garrett Corp.'s Allentown Manufacturing Co., has been appointed to the National Aeronautics and Space Administration's Advisory Committee on Medium-Range Missions.

Henry Rausch, president of International Electronics Research Corp., has been elected president of the Strategic Industries Assn., Los Angeles, Calif.

Fredrik L. Holman, chief of expansion and market development, Avco Elbit Systems, Bell Aircraft Corp., has been elected to the National Aircraft Standards Committee of the Aircraft Industries Assn.

Changes

E. J. Lundberg, president to E. H. Heinsohn, vice president/division counsel as cash systems manager, Douglas Aircraft Co., Inc., Santa Monica, Calif.

G. W. Tschirhart, military advisor to the group manager, McDonnell Douglas Corp., St. Louis, Mo.

Richard E. Roberts, head of the newly formed Instrumentation and Communications organization of General Electric's Missile and Space Vehicle Department, Princeton, N.J.

(Continued on p. 45)

INDUSTRY OBSERVER

►Escape systems tests for the National Aeronautics and Space Administration's Mercury Man-in-Space project already have begun under direction of Langley Research Center. Wind tunnel and landing impact tests began last October. NASA has awarded Theodol, Inc., \$10,000 for 2024-1961 research for escape systems.

►Gyrodyne, Inc., helicopter under evaluation by Navy for use aboard destroyers will be used primarily as a "soft" weapon against submarines. Navy will rely upon destroyer gun to find the submarine, then launch the planes carrying small gyroplanes to fire missiles in an effort to compensate for the World War II destroyer's lack of speed in relation to that of a nuclear submarine. Designations of gyroplanes under evaluation are the single-engine ASN-1 and twin-engine ASN-2. Powerplants being used are modified Pneumatic auto-turbine engines.

►Fourth bidder for Army's Mauler anti-aircraft weapon system (AW Feb. 9, p. 23) is The Martin Co. The four bidders for contracts were Day originally had had Phase I test contracts for the system. Award is expected within the next six months. Other three bidders are General Electric, Convair and Sperry.

►First three squadrons of Convair F-106 interceptors are scheduled to go into operational service this spring at early summer at McGuire AFB, N.J., Eggers AFB, near Spokane, Wash., and Andrews AFB, Md.

►Third site for the ballistic missile early warning system (BMEWS), which the U.S. Air Force would like to locate near Fairbanks, Alaska, has become the subject of a diplomatic dispute between the U.S. State Department and the Soviet Foreign Office. USAF believes the third site is necessary for maximum efficiency of the missile detection system. The British consider the site a prime target in case of war and are reluctant to grant permission for its installation.

►Lithium, lighter but more reactive metal, is not being overlooked by Air Force scientists as a possible structural material for future space vehicles. ARDC researchers have just published its tensile strength at 64 mil. And although useful in kept under oil to prevent it from bursting into flame, the feeling is that it might prove serviceable in the near vacuum of space.

►Bureau of Aeronautics has begun procurement of berillium wire for use as a reinforcing element in new composite aircraft structural materials.

►Navy plans to incorporate some anti-submarine "SAC" potential into the Polaris fleet ballistic missile subsystem—possibly the Polaris submarine-to-air-to-underwater long range weapon now being developed by Lockheed Aerospace Corp.—to avoid necessity of having to supply subs with acoustic hunting filter subsystems for protection.

►Convair's Chang is flight testing another new aircraft—the "Yuma-2," built at the Northrop Fabriches facility. The single engine biplane has a top speed of 123 mph and a ceiling of 21,480 ft. It can carry four to six passengers and also may be used for sports flying and agricultural work.

►Under present planning, Navy will eventually have a total of 35 ships equipped with either the Convair Tern or Triton surface-to-surface guided missiles. Triton ships will include five operational-priority cruisers, a medium-priority cruiser and aircraft carrier, a medium-priority frigate, two Frigate-class carriers, a destroyer and 19 destroyers. Tern ships will include three carriers and 18 destroyers.

►De Havilland of Canada has increased the gross weight of the DEHC-4 Caribou from 24,000 to 26,500 lb. to provide a greater payload and lengthened the cabin by 45 in. to accommodate an added row of seats which boosts passenger capacity of the aircraft to a total of 30.

Propulsion through the ages...



Propeller-driven airplane designed by P. R. M. Meissner, 1914

An astounding proposal - in 1914, just a year after the invention of the biplane, the Frenchman J. R. M. Meissner composed an order embodying the essentials of the modern jetplane. Beneath the gas bag hung a gaudily contoured engine. There was a cumbersome cooler and three manually-operated propellers. A proper power plant was lacking, however, and perhaps that is why the dirigible measured a dozen or another century. Aero-designs of today are more fortunate. They

have the proper power plants available, and have fixed propellers' to them, creating turbo-jet power parlance. The firm people, for example, designed, developed and produced the propellers for the first four-seat aircraft and now supply over 100 engines and aircraft operators around the world who want to travel relatively. Small turbo-props are standard equipment on the Vickers Viscount, Fairey F-27, Grumman Gulfstream and Fokker Konvolut.

ROTOL

The world's most experienced manufacturer of turbopropellers — over 6,000,000 hours of flying time.

Rotol Incorporated offers extensive service throughout the United States. We provide immediate spare parts delivery, technical service on propeller operations and applications.

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Washington Roundup

ARDC Shakeup

Watch for a major shakeup in Air Research and Development Command after the naming of a new commander to succeed Lt. Gen. Samuel Anderson who was recently promoted to command Air Materiel Command. Considered by ARDC staffers to be the "best candidate" in the Service, he was selected by a special committee headed by Dr. Conrad Stroess, former Air Force chief scientist and professor at Massachusetts Institute of Technology (AW July 16, p. 39). One of the biggest problems facing ARDC is reduction of its headquarters workload and placing increasing emphasis upon exploratory research aimed at basic title of the art objectives in current areas.

New Bid for ABMA

Also look for the National Aeronautics and Space Administration to make another announced attempt to award a portion of the Army's Ballistic Missile Agency at Huntsville, Ala., to one of the contractors. It is considered likely that the House and Senate defense committees during the past few weeks, NASA administrator Keith Glennan has presented to the feasibility of such a transfer. Glennan and his staff have drawn a responsive chord in Congress when he said NASA requires the capability to assemble and ground test space vehicles and to support its subsequent launching operations. To build such an organization with the present facilities Glennan says would require considerable funding while the transfer could be accomplished at relatively low cost.

However, Army resistance to such a transfer is not expected to be dissolved.

NASA Information Policy

In another area, professional and amateur of both the House and Senate space committees are considering the possibility of an inquiry into the public information policies of the National Aeronautics and Space Administration. The act creating NASA directs the agency to provide the "widest, practicable and appropriate dissemination of information concerning its activities and its results therefrom." Complaints mounted by staff members indicate that top officials seem reluctant to make public plans and programs of the agency.

Jet Surcharge Approved

International Air Transport Association traffic conference last week approved a jet surcharge on North Atlantic and South American routes to be effective April 1 as predicted by AVIATION Week last Oct. 27 (p. 26). Surcharge on first-class and lie-flat seats on North Atlantic routes will be \$20 while the surcharge for tourist and economy class seats will be \$15. On South American routes, the surcharge will be based on a progressive scale pattern according to mileage. For example, the surcharge on first-class and tourist flights between New York and Buenos Aires will be \$10. No surcharges will be charged on jets operating in the Eastern Hemisphere. Pacific routes will be studied at a later date to determine whether a surcharge shall be adopted when planes are scheduled on those routes. Carga route on certain commodities shipped now and North Atlantic routes were reduced about 30% below present rates.

Penalty Plan

Legislators setting penalties of up to a \$10,000 fine and a year's imprisonment for participants in Civil Aeronautics Board cases who inflate off-the-record communications to CAB attorneys or witnesses has been authorized by Rep. Owen Harris (D-Calif.) as a follow-up of a study of the operations of regulatory agencies by House Committee on Government which he heads (AW July 12, p. 43).

Even if the measure is not enacted, CAB members and employees would be required to place off-the-record communications in a public file.

If the communication is oral or telephoned, a statement would be filed. Failure to do so also would be subject to a penalty up to \$10,000 fine and a year's imprisonment. Harris' measure also would:

- Establish a detailed code of ethics for Board members and employees
- Provide for selection of the chairman and vice chairman by Board members, instead of by presidential appointment

• Require that one Board member propose or personally direct the preparation of each Board decision. The member responsible would be identified in the document.

Meanwhile, Harris is seeking a \$200,000 appropriation to continue the investigation of CAB and other regulators approved by a Commerce subcommittee which he will lead again this year.

In Congress

Meanwhile, in other Capitol Hill action:

• Nuclear assault. Rep. Albert Thomas (D-Tex.) is urging Air Force to withdraw its nuclear aircraft project from General Electric Co. and place it with a new contractor. Thomas is chairman of the appropriations subcommittee which oversees Air Force spending. General Electric and was appointed to the Joint Congressional Committee on Atomic Energy this year. "The time has come to change," Thomas declared. "General Electric has been working on the project for eight or nine years. Sometimes when one man can't do the job, another can." Rep. Melvin Price (D-Ill.), chairman of the Joint Atomic Energy Committee's subcommittee on research and development, took some issue with Thomas, saying, "I see no cause for complaint with the contractors on this project," he commented. "They have met every schedule that has been set, and the next step is to put the project into full production. I think we have held back a bit because of the cost factor."

• Gas taxes. Rep. Wilbur Mills (D-Ark.), chairman of House Ways and Means Committee is opposed to the President's proposal to increase the tax on aviation gas from 2 to 4-5 cents a gallon and also levy a 4.5 cent tax on jet fuel. Mills opposition comes the measure has little chance of congressional approval. He is not yet committed on a levy of two cents a gallon on jet fuel, new bill first.

• Radio frequencies. House has voted the Commerce Committee \$10,000 for a comprehensive study of the radio spectrum and policy as the need of frequencies. Authors object to the relatives regulation of frequencies by the Federal Communications Commission and Armstrong Radio, Inc., now have a court case pending against the FCC for withdrawal of frequencies needed for wireless communications services from government use.

—Washington staff

tions and associated systems station is needed to track a re-entering satellite between the northern and eastern axis of the U.S. He proposed that the station be located in southern Texas and equipped for precise tracking of satellite being launched northeast from Cape Canaveral on the line close off.

Cost breakdown includes:

- Extension and improvement of satellite electronics tracking stations-\$3.3 million. Of this, \$2,124,000 is for equipment and facilities for new stations; \$1,010,000 for antenna stations; \$1,000,000 for equipment and software; and \$730,000 for one propagation and analysis. Another \$1,176,000 of the total is for modification and improvement of existing electronic tracking stations, of which \$720,000 will go

for a network of 12 stations to change radio frequency, \$130,000 for digital read-out equipment, and \$100,000 for user analysis at ten stations.

- Facilities for space probe tracking outside \$1.5 million. Of this amount, \$1.3 million is for manual tracking stations, small vehicles and housing at two stations, \$190,000 for five 15-ft. dia earth antenna stations, \$168,000 for one radio tracking station and \$70,000 for two autonomous level control stations.
- Equipment for support of manned space vehicles-\$1,000,000. This includes \$1,176,000 for equipment and software for the International Space Station and ground station, \$1,250,000 for precision radar for stand-off orbit tracking and control and \$1,176,000 for precision radar for end-of-course and landing tracking.

Space Technology

NASA Awards Scout Contracts

Washington—Contracts for the 70-ft., 16,000-lb. Project Scout general purpose space rocket (AW Feb. 1, p. 26) have been awarded by National Aeronautics and Space Administration, and Antracite Inc. is in the process of selecting contractors for Scout's military counterpart.

NASA and USAF will supervise development with a joint team; USAF's vehicle-Systems Division will differ from Scout in several respects.

Both are intended to be modular rockets with stages that can be used in various configurations. The Scout will use solid propellant. With the possible exception of the third stage, all are off-the-shelf items.

Scout will be assembled at Langley Research Center and fired initially from the nearby Morton Aircraft Research Station at Wallops Island, Va. Anstracite has not yet been awarded.

Four Scout variants of four stages and midship will 150 lb. to orbit or send a payload of up to 100 lb. to an altitude of 5,000 ft. It also will be used as high-speed entry-test vehicles and boosters.

• **First stage**—Anstracite Corp. is Anstracite's contractor with more than 100,000 lb. of thrust. That engine originally was called Jupiter Seven when the Jupiter intermediate-range missile still was a joint Army-Navy project. At the time it was the largest solid rocket that had been built. It powered an early Polaris test vehicle. Contract is let through Navy's Red Devil, total \$1,019,000.

• **Second stage**—Tastek Inc.'s contract for the second stage model designated X-32-20. Contract is awarded through Antracite. Total cost \$620,000.

• **Third stage**—Anstracite's Letherton's X-254 engine, a scaled-up ver-

sion of the X-254 used to change radio frequency, \$130,000. For digital read-out equipment and \$100,000 for user analysis at ten stations.

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This final phase program also includes a \$123,000 option to ARMA-Traveler for XOM 45 reentry escape rockets.

- Second stage of Mercury testing will use Chrysler Redstone boosters equipped with capsules that will carry monkeys and, on later flights, apes and a man. Contract to Army Ordnance Missile Command for fiscal 1959 is \$4.47 million, with the final contract not expected to reach \$15.5 million.

- Third phase will use Chrysler Jupiter boosters and also will include use of Atlas boosters. The first three planned capsule flights are likely to be orbital. Contract to Army Ordnance Missile Command for fiscal 1959 is \$2.74 million, total contract cost is estimated at \$4.45 million. ARMA will make the necessary modifications to the Chrysler-produced Redstones and Junipers.

- Fourth phase will use Convair Atlas D boosters which will put the unmanned capsules into orbit. Two contracts have been let through Air Force Systems Division and the planned fourth project. NASA has not explained what role we would be in the Scout program, but it may be for spin substitution as recommended. Contract is let through AFMVA.

Contract and spin stabilization contract for the fourth stage will be done.

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Rocket Contracts Let

For Project Mercury

Washington—Contracts for rocket vehicles to be used in four phases of Project Mercury, including a solid-propellant Little Joe vehicle for the first flight, have been awarded by National Aeronautics and Space Administration.

Another short designated Big Joe and using an Atlas, will be fired sometime this summer. Atlas will carry the thermal heat shield and some other basic components of the second capsule to a great height on a near vertical trajectory to test entry heating.

Little Joe in the transport vehicle for the first solid-stage tests. Details of the vehicle and the coverage of its operation were first revealed by

Contractor to Anstracite Missile Command.

National Aeronautics and Space Administration

Functional Breakdown-Budget and Development-Fiscal 1960

Program	Contracts For				Total
	Somatic and technical studies	Prototypes and experimental hardware	Operations and technical services	Supplies, equipment, repairs, and alterations	
AEROBAT, MISSILE AND SPACE CRAFT RESEARCH					\$16,879,000
Support of NASA pilot	1,000,000	1,000,000	1,000,000	1,000,000	3,000,000
Support of JPL pilot	1,000,000	1,000,000	1,000,000	1,000,000	3,000,000
Research research	\$1,000,000	1,000,000	1,000,000	1,000,000	3,000,000
SCIENTIFIC INVESTIGATIONS IN SPACE					39,000,000
Booking vehicles	900,000	86,000,000	1,000,000	2,000,000	39,000,000
Earth satellites	3,000,000	3,000,000	9,000,000	3,000,000	61,000,000
Low orbits	3,000,000	17,400,000	2,000,000	1,000,000	24,400,000
Deep space probes	4,000,000	17,000,000	1,000,000	700,000	27,000,000
Vision project					
BALISTICS APPLICATIONS INVESTIGATIONS					74,800,000
Meteorology	1,000,000	8,000,000	1,000,000	800,000	14,800,000
Communication	1,500,000	6,500,000	1,000,000	1,000,000	21,000,000
SPACE OPERATIONS TECHNOLOGY					73,000,000
Manned space flight	1,000,000	9,700,000	21,000,000	6,000,000	37,000,000
Space maneuver techniques	1,000,000	1,000,000	1,000,000	1,000,000	3,000,000
SPACE PROPULSION TECHNOLOGY					17,000,000
Solid fuel rockets	400,000	1,000,000	1,000,000	100,000	1,000,000
High energy fuel rockets	3,000,000	11,000,000	10,000,000	17,000,000	30,000,000
Liquid & storable single chamber rocket	3,000,000	30,200,000	200,000	100,000	30,300,000
Nuclear rocket engines	2,000,000	5,000,000	200,000	100,000	6,000,000
Space impact	1,000,000	1,000,000	100,000	100,000	1,000,000
Auxiliary power units	2,000,000	2,000,000	100,000	100,000	2,000,000
SPACE SYSTEMS TECHNOLOGY					1,000,000
Advanced vehicle systems	1,000,000	1,000,000	100,000	100,000	1,000,000
Booster recovery systems	1,000,000	1,000,000	100,000	100,000	1,000,000
Orbiting space laboratories	900,000	900,000	100,000	100,000	2,000,000
SUPPORTING ACTIVITIES					31,500,000
Testing and data acquisition	100,000	1,000,000	7,500,000	1,700,000	11,200,000
TOTAL RESEARCH AND DEVELOPMENT	\$17,200,000	\$20,000,000	\$41,640,000	\$15,921,000	\$93,181,000
• Functional loadlines not available.					

35,000-ft. Sled Track Tested

Holloman, AFB—An 80-ft. flywheel magnetron in 35,000-ft. high speed sled track has worked with a super sensor to which two bits of iron were added in a different track.

The sled moving the iron was boosted to a speed of 1,000 mph by an Anstracite Megablast solid rocket motor that delivered 100,000 lb. of thrust during an 18-second burn period. Sled traveled nearly 10,000 ft. to a stop at a zone before it reached the water table at the end of the track.

During the magnetar vibration characteristics of equipment aboard were tested and results were made available at a recent meeting of the Magnetic Fluids and Materials division of the Aerospace Field Laboratories. One of the tests made in a hypersonic rig in which a sled was run at a position where a

which it was plowing out at the company's McGregor, Tex., plant.

Megablast learned to adapt the sled was constructed of aluminum to withstand repeated impact segments as required for its application for the sled and held in place by a system of steel rods and plates.

Several Megablast motors have been used for track motion at Holloman in the past.

Broder used in the sled run involved was produced with two versions by Rocket Park Division of Phillips Petroleum Co. Since this division was absorbed by Anstracite, a subsidiary of Phillips and North American Aviation, The 21 ft. x 12 in. sled was built 2,000 ft. in total and tested under varying climatic conditions before its use.

Megablast became the 80 ft. in diameter, weighed 3,000 lb. empty and 4,400 lb. loaded.

development of advanced weapon systems such as CF-185 is too costly for a nation with approximately 17 million people to sustain alone.

The government reiterated its plan of relying upon the Boeing Co. wide inter-force model for the final design of Canadair under an arrangement whereby the U.S. would bear two-thirds of the cost and Canada one-third.

Dissension in fact developed between the government and the committee over several major points concerning the Avro program, particularly total cost. The committee said one of producers of 100 aircraft would be less than \$1 billion each, the government said the cost at approximately \$7.8 billion. The government figures were not formally challenged during the debate on committee.

Another reason for the CF-105 cancellation, according to Diefenbaker, is that "already the U.S. Air Force has decided not to continue with the fighter development and production of U.S. aircraft." Among the more general performance of the Avro. During the debate in Commons, he defended the U.S. aircraft as the Canadair F-186 Musketeer's speed of 770 mph is approximately 10% faster than the CF-105 has a potential of 530 mph.

Later in the debate, Diefenbaker, who said from Canadian newspaper and general reports to make many of his points quoted an article which said

that the Arrow was capable of speeds of 1,000 mph, but only at short bursts.

The Musketeer would pilot the Avro aircraft close to the general performance category of the CF-105, making it difficult to match Avro's aircraft which is scheduled to be delivered over the next six to eight years.

It has been widely reported in Canada that the Avro Avrocopter, flying with Pratt & Whitney JT5 engines have approximately equalled the world speed record of 1,043 mph right out of the Lockheed F-104. The serial flight test Avro was racing its serial flight due to be powered by Ontario Hydro turbines which will increase the power available to 30% above the present figure. The aircraft's current world record is 1,043 mph.

Parliamentary sources say that the Avro will add 400 to 500 mph to the aircraft's top speed and bring it to the Musk 3 speed range.

Fanshawe of evan passing whether the Avro and its Hispano engines could reach this speed free of serious technical or mechanical problems. It would be virtually impossible to continue a flight test program in such an early stage without large-scale engineering support which the government is not prepared to give.

Diefenbaker also said that the Avro could not enter general squadron service until 1972 when long-range ballistic missiles would represent the primary threat to North America.

According to government estimates, Avro expenditures in excess of its development and production schedule would have come close to 10% of the on-call defense budget.

Diefenbaker said that "the cost of the Bomarc missile to Canada, as compared to the \$581 million for the CF-105, is approximately \$103.8 million. That represents something that may be taken into consideration, all things being equal, and the defensive aspects to be considered in the future."

Political thought in Canada now seems to more firmly believe that Canada will lose an advantage if it does not have the technological capability to develop advanced weapons and does not go marching for its own delivery to itself at the end of the scale. If the U.S. will not share responsibility in defense production, Canada should withdraw gradually from the North American defense picture and let the U.S. carry the burden alone.

Hollett of the latter view point to the effect that U.S. planes have been to the moon in February of 1969, and that, with the U.S. putting a large share of the defense costs, and that most of these economies has left its aircraft. They add that strings to Canada entered by the terms of the defense contract to the U.S. could then be regarded as an economic development of the country.

Diefenbaker and most of his supporters are pursuing a course falling be-

tween, it feels that the information passed could add a potential entry.

Official position of the Royal Canadian Air Force to the cancellation of the CF-105 is nothing more than a Canadair losing its bid to match another producer except through the evident inaction of the government.

However, Air Marshal Ray Shiner, RCAF deputy commander of the North American Air Defense Command, made his support of the CF-105 public last November and was attack upon him in Ottawa. Shiner said:

"We would be derelict in our duty to make accommodations in which we seemed belittled. ... If I lost my second position, I can't possibly go to another congressional committee. I'd be lost."

In discussing the CF-105 performance, Prime Minister Diefenbaker said he found no published report that the fighter's combat radius was as high as 500 km. He said that such a range did not warrant calling the aircraft a long-range fighter at least based on present knowledge.

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Diefenbaker and most of his supporters are pursuing a course falling be-

tween these two extreme views.

Anti-American feeling is being expressed in some quarters because USFZ failed to show any positive interest in the Avro program and several other Canadian companies were awarded contracts. This has, however, an strong sentiment has developed, and some judgment probably will be reserved until the outcome of U.S. and Canadian productions sharing efforts become clear.

Political exchange between the government and A. V. Roe was bitter after the committee's testimony. It included: • A. V. Roe and it had no advance warning of termination. The government had put in money for us to do.

• Diefenbaker and company management had discharged all its workers in an effort to enhance the government Avro and it had to discharge everyone and then refuse according to someone to abide by union agreements. The estimated Avro-Canada payroll was around \$1 million a week in their employment period of two weeks ago.

• Diefenbaker spoke at length in Committee about the Avro "Jolley" and the severe pressure the company applied to him to bring him to heel in an effort to save face.

• Government and the company had failed to propose any serious plan for alternative work if the Avro were terminated.

Avro's response was:

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Discoverer Absorbed

Vancouver, April 2—Searle U.S., attempting to launch a polar orbit into the sky, exploded a solid rocket which exploded last Wednesday only a few seconds before launch time. The short came after three fire losses of "bullets" of the fully fueled rocket. Although no official description of the technical difficulties encountered has been forthcoming, the short may have resulted from valve leaking caused by the liquid oxygen used in the first stage during the long delay.

A previous attempt to launch the Discoverer 10, No. 22 was canceled as a result of an instrument failure by pad personnel when the U.S. Air Force failed to show the starting technique of initiation was ready for uptake. When the satellite launching rod was set up, damage for safety reasons, never repaired, until the first stage fell back. The second stage is the Bell Model 3000 stage.

\$18,225 less than the energy aimed in 1957.

Company officials told stockholders the firm is engaged mainly in the DC-6 and DC-7 cargo transport programs, fewer deliveries of DC-6 and DC-7 passenger-driven transports, a projected freighter division is planned in the federal government of \$100,000,000, and increasing labor and materials costs.

Discoverer's losses increased 80.8% over the previous year, with sales of \$111.6 million, compared with \$59.9 million in 1967.

Net income net sales were \$33.6 million.

At the close of the fiscal year (Nov. 30), the company employed 1,728 workers, down 4,400 from a similar period in the previous year. Company said a further reduction in work force will be made in 1974, adding "that decline might be considerably greater than that in 1973, according to estimates based on present firm sales and letters of intent."

The earnings were held only last month, said Diefenbaker and the A. V. Roe management. No statements were made after the meetings except government assurance that taxes were being applied to find employment for the Avro and Canadair workers.

Douglas Sets Sales Record; Profits Drop

Santa Monica, Calif.—Douglas Aircraft Co. sales in 1969 reached a record high of \$3,210,459,000, but net earnings dropped to \$35,947,220, or 51.3%

of 100 sounding rockets to be fired from Whidbey Island, Va., and Ft. Churchill, Can., in 1959 and the first fall of 1960 have been moved to Naval Research Laboratory by the Space Sciences Division of the National Aeronautics and Space Administration. The division also has contracted with NRL for \$5 million worth of instrumentation on 15 test flights and space probes that are to be fired via the U.S. and Canadian governments sharing efforts before spring.

Political exchange between the government and A. V. Roe was bitter after the committee's testimony. It included:

- A. V. Roe and it had no advance warning of termination.
- The government had put in money for us to do.
- Diefenbaker and company management had discharged all its workers in an effort to enhance the government Avro and it had to discharge everyone and then refuse according to someone to abide by union agreements.
- The estimated Avro-Canada payroll was around \$1 million a week in their employment period of two weeks ago.
- Diefenbaker spoke at length in Committee about the Avro "Jolley" and the severe pressure the company applied to him to bring him to heel in an effort to save face.
- Government and the company had failed to propose any serious plan for alternative work if the Avro were terminated.

According to government estimates, Avro's expenditures in excess of its development and production schedule would have come close to 10% of the on-call defense budget.

Grand Rapids Division of Lear, Inc., received a \$5 million follow-on order for corporate communications for Boeing's B-52, B-58, B-52A missile control and missile ground support equipment to Systems Division of Consolidated Electromechanics Corp. Equipment includes high pressure helium and nitrogen control systems and an checklist of Altimeter and fuel system prior to landing.

Stony Creek Division of Lear, Inc., received a \$5 million follow-on order for corporate communications for Boeing's B-52, B-58, B-52A missile control and missile ground support equipment to Systems Division of Consolidated Electromechanics Corp. Equipment includes high pressure helium and nitrogen control systems and an checklist of Altimeter and fuel system prior to landing.

Riddle Airlines last week signed a positional order for four Armstrong Whitworth 618 transport cargo aircraft as an eventual replacement for its present fleet of 12 low-capacity, high-operating-cost Cessna 441s (AVW Feb. 16, p. 35). Unfinished sources said the aircraft will sell for \$1.5 million each. Terms to the series reportedly include 10% down and no payments until the end of year, with the total purchase price expected to be spread over a several-year period.

Intelligence Schism

OTTAWA—Various Canadian government's interpretation of intelligence on the Soviet侵攻 potential and that of the U.S. government represents from the same information, bearing report during House of Commons debate on the cancellation of March 3 Avro CF-105 interceptor. Minister of National Defense G. R. Peacock said:

"All of the information we can get from the sources available to the government indicates that the threat of the invasion bomber is decreasing."

At another point, Peacock told Commons that "the invasion has been there but the Russians are not continuing the production of any type of bombs and aircraft, and that the number of Bear and Bison aircraft in the Russian inventory is extremely limited and, further, that there are only two types of Soviet bombers which could reach the continent."

The Defense Minister also challenged a statement by an opposition member of Parliament that military observers usually said that the Russians in the mid-1960s would still have an inventory of 1,000 to 2,000 bombers capable of striking Canada in addition to its inventory of conventional ballistic missiles.

Peacock replied that the statement "must not be taken as indicating that these 2,000 bombers could reach the entire area from a small fraction of that number could easily make the entire region if they were equipped."

U.S. policy intelligence has reported that the Russians were keen under development a supersonic bomber code named the "Bomber." While USAF in 1957 assessed development in existence of Soviet production of the Bear jet bombers after it became evident to the Russians that the Soviets would have difficulty in developing an intercontinental missile, there has been little since suggests that the Soviet bomber threat has diminished. Development of the Bomber apparently was designed to provide an effective replacement for the Bear.

Details and initial test flights of a prototype of a Soviet nuclear-powered aircraft were first reported by Aviation Week in an exclusive story last Dec. 1, (p. 27).

AIR TRANSPORT



WEST COAST AIRLINES is operating its turboprop Fairchild F-27s like the one shown, along with a fleet of 14 Douglas DC-9s.

F-27s Boost West Coast Revenue Miles

In first three months' operation turboprop aircraft increase revenue miles flown; draw new customers.

By William S. Reed

Seattle—Introduction of turbine equipment by West Coast Airlines has in the carrier's three months' experience with the aircraft increased the rate of revenue miles flown, attracted new customers and brought about a general expansion of business.

West Coast integrated its 40-passenger Fairchild F-27 service September 1958, and produced some surprising figures for October, the first month of operation. During September, 1958, operation on certain selected routes, Douglas DC-9s carried 385 passengers per day. During the first full month of F-27 operations the same route yielded 845.5 passengers per mile, an increase of 48.76%. In passenger miles, the increase was from 1,861,248 to 1,576,778.

Internal studies despite the normal seasonal decline in business experienced over the winter, the airline stated. West Coast and the F-27s, however, might have been due to the novelty of the F-27 and the fact that nearly eight hours daily turboprop aircraft schedules to the sea areas. Thus, even the most cautious and venturesome

saw that, for December, West Coast's six F-27s flew 2,173,641 pm freight index.

For actual cost per seat mile were not available since the company had no right to determine the cost of an aircraft prior to change. Itemizing fare in all types of passenger aviation 36 items. As a result, news became via passenger instrument approaches, landings and takeoffs, but stage lengths received are not clear.

Company Financing

West Coast has had financial success but has had financial setbacks. Its president, Nick Fox, through other business interests, was able to give considerable time enhanced credit standing to the line.

Once the decision was made to re-equip, West Coast obtained two SE railroad box loads, one from a Texas

airline and one from a local lumber company. Recently Civil Aeronautics Board reluctantly actioned and via additional \$600,000 of route with 15 added intercity routes, stage length is about 65 mi., with shortest length 28 mi., and longest 204 mi. Total stage length computed for the F-27 operation is about 125 mi., but this cannot be solved unless data stage length is granted by the CAB.

This doesn't mean West Coast would discontinue service to small communities but rather that aircraft would not stop at every station on every flight, thereby minimizing the average stage length to the route normally operated by the Douglas. West Coast's pilot crews around the state of Washington average 36 stops. As a result, news became via passenger instrument approaches, landings and takeoffs, but stage lengths received are not clear.

bank. An additional \$750,000 was raised by disposal of surplus assets and subscriptions to stock by company officials. Thus, West Coast is still in the position to avail itself of a Civil Aeronautics Board guaranteed loan, should it become desirable to refinance and raise additional capital. Although \$4.75 million was more than needed for purchase of six aircraft, capital was needed for purchase of training aids and anticipated expansion of routes.

Although new aircraft have been in service not short a time, to provide an early forecast of future earnings, it is confident that the F-27 will be good revenue producers. West Coast sees the airplane as a means for getting the local tourist flows off subsidy.

F-27 Maintenance

Few bugs have shown up on the F-27, according to West Coast. Trouble involved G ring failure in fuel piping, rectangular rivet failure, and nose wheel retarding cable breakage. Fuel piping and riveting troubles were eliminated by fast stress concentrations and nose wheel retarding cable breakage was eliminated after a few trials and was temporarily lowered from 170 lb. to 140 lb. Fairchild Airlines & Export Co. is developing fixes on nose wheel cable linkage. Maintenance programs are about under way in which Fairchild will send teams with vans late to each user's base and perform work at inspection intervals.

Another modification which affects the first five months delivered to West Coast is the cabin air conditioning blowers. In flight, the blower makes an obtrusive, high-pitched noise. This sets off alarm bells in West Coast's ortho auditor but modification in the field will be necessary for the first five.

Still another difficulty appeared in the passenger cabin which operates the landing gear, nose wheel steering, passenger entrance door and the rudder, parking and propeller blades. Moisture



problem affected the pressure relief valve which caused damage to insulation in the galley. This was located directly ahead of Seattle. The door, which encloses the valve in flight, thus caused the valve to freeze. This caused ice emergencies but did not affect the valve or the valve and de-icing system as part of the engine driven compressor.

Comparison of Selected Flights

(Including extra section)

	Total Passengers Per Route	Passenger Rate Economy
1000 mi. Seattle to Anchorage Pals	100.7	\$10.7 plus 24.2%
1000 mi. Portland to Anchorage Pals	100.4	\$10.4 plus 23.9%
1000 mi. Anchorage to Seattle	100.3	\$10.3 plus 23.9%
1000 mi. Anchorage to Portland	100.2	\$10.2 plus 23.9%
1000 mi. Seattle to Los Angeles	100.6	\$10.6 plus 23.9%
1000 mi. Anchorage to Los Angeles	100.5	\$10.5 plus 23.9%
2000 mi. Anchorage to Honolulu	101.5	\$11.5 plus 27.4%
2000 mi. Honolulu to Anchorage	101.2	\$11.2 plus 23.9%
2000 mi. Anchorage to Honolulu	101.2	\$11.2 plus 23.9%
Total	940.3	\$10.8 plus 23.9%

One of the Rolls Royce Dart 6 prop engines on the oldest F-27 was removed after a total of approximately 750 h. of revenue flying. Removal was necessary, not due to failure, but due to so that originally scheduled engine removals for overhaul work could be staggered. Rolls Royce reported back to West Coast from its Canadian factory that the engine showed nothing worse than some wear.

Eggape Keys

One other minor engineering change contemplated by West Coast is modification of baggage bins. Baggage was carried in two large bins forward of passenger cabin. These are slightly inclined, according to West Coast, but must be subdivided. Anticipated is to install a shelf in each bin so that baggage need not be loaded in stacks. Because of short loads, it has frequently been necessary to roll load baggage to get at pieces which are on the bottom of the pile. Loading shelves, a simple matter, will eliminate this difficulty.

Some of West Coast's planes were practically swathed in the DC-3 and, as such, viewed the new F-27 with a some

Aircraft Comparative Operational Statistics

December, 1958

AC-3 Aircraft No.	Power Hours	Revenue in Millions of Dollars	New-Rate Revenue	Fleet No.	Ave Daily Rev. Mill. \$.
101	-	31	110.42	11.04	3.08
102	-	21	104.42	10.44	4.17
103	-	21	129.00	12.90	5.98
104	-	21	166.00	16.60	8.00
105	-	21	101.92	10.19	4.16
106	-	21	149.04	14.90	5.98
107	-	21	116.00	11.60	5.43
108	-	21	156.00	15.60	5.48
109	-	21	120.00	12.00	5.20
110	-	21	98.80	9.88	4.01
111	-	21	105.00	10.50	5.00
112	-	21	104.00	10.40	4.82
113	-	21	101.17	10.12	4.63
114	-	21	101.17	10.12	4.63
Total AC-3 Rev. December, 1958	426	1059.50	105.95	149.04	5.08
P-37 Aircraft No.	Power Hours	Revenue in Millions of Dollars	New-Rate Revenue	Fleet No.	Ave Daily Rev. Mill. \$.
201	22	325.10	32.51	107.07	3.04
202	22	140.20	14.02	107.07	4.01
203	22	805.00	80.50	908.35	8.00
204	22	108.20	10.82	107.07	3.87
205	22	325.00	32.50	107.07	3.04
206	22	38.84	3.88	106.41	3.64
Total P-37 Rev. December, 1958	173	835.10	83.51	902.34	5.09
P-37 For entire year to Dec. 31, '58	463	2029.50	202.95	1066.04	4.35

what preceded over. However, once transition to the new equipment was completed, they were soon over. This is reasonably indicative when talking about the aircraft. Your operators of West Coast's routes made for a hard day in the tour office, but little factors are considerably reduced in 1957. Copley works a lot harder because the same amount of your work and responsibility now lies in his hands as in the DC-3, but he does it easier.

Comparative operation on west and west routes is incentive for your stations and that is now as P-37 is than in DC-3 type. P-37s are not equipped with thrust reverser, but placing the propellers on flat pitch provides very good braking effect. Landing at Seattle's Boeing Field as a wet runway is a real need, therefore, the P-37 needed power applications to roll off at halfway point. This was accomplished without use of brakes.

Training for emergency in P-37s cost West Coast about \$7,000 per acre. Training is cost of approximately between 11 and 20 hr of flying time. 100 hr of ground school, and new syllabus. Complete training kit in the Dart engine/propeller combination was

purchased from Bell-Rover, no address to enough time I could fit in the jet frame. Training will continue until all of West Coast's 26 crews are transferred. Thereafter they will get periodic refresher course.

Ardash also has had to lay about 60 additional ground personnel in a series of increasing bottoms. Baggage handling and relating operations of preflight and postflight, as well as the maintenance and additional personnel is all included when new route go into effect.

The fact of F-27 aircraft is showing West Coast considerable interest and this is where DC-3 Special Regulation 423A, restricts the aircraft's takeoff gross weight. SR 423A is applicable to all turboprop aircraft and makes no distinction between transports and turboprops. Thus, turboprops must put the same penalty as transports even though they do not suffer a great thermal loss when operating at elevated temperatures. Turboprops suffer a greater loss of efficiency at elevated temperatures due to increased frictional losses but not as much as transports.

Copair Pacific has had no groundcrew men, runs a very tight, small organization. The efficiency of Bellfield

accountability has a better single engine performance than a DC-3 passenger fleet must be reflected in some stations when maximum temperature reaches 50°F. It is the second highest climb gradient portion of SR 423A. But here, the F-27 and West Coast happen the Cessna will take advantage of the difference between turboprop and turboprop performance and make adjustments in the right direction.

Generally, West Coast's management feels that things are definitely looking up for the local service airfield. Travel times, once estimated to be 10 hours, are now down to 7 hours, and are continuing to shorten. Now that an already load to prevent maximum operation or short hauls is available, travel costs reflect the value of freedom and have gone up so much which they have not been able to operate with their larger equipment. Local service cannot also appear to be limited for daylight out of the financial winds and expect to find a place as a permanent part of the nation's economy.

Malayan Considered In Hong Kong Merger

Hong Kong-Macao of Hong Kong may be followed by merger of Malayan Airways and Cathay Pacific Airways. Airways with the two combine reliable routes here before. Negotiations are reported under way.

In effect, Cathay Pacific is rising over Hong Kong Airlines' routes. Hong Kong has operated under heavy losses for the past three years, but now has come out of losses. Overseas Airways Corp., a sister company, was prepared to support the losses but the other owner, Justice Matheson & Co., Ltd., was not.

BOAC will continue to have a major share in the new company and a position at London, Matheson will hold a seat on the board of directors. Cathay Pacific is principally owned by Matheson & Co., Ltd.

Cathay Pacific has originally originated in London, but now has its main base in Hong Kong after the Chinese Civil War. World War II, Britain and Britair brought the airline to the early 1950s period and expanded its route network in the south as the hope of forming a great part of the Chinese empire still exists. In which Hong Kong Airways, being born out of Hong Kong, was to have joined in mainland China. The fall of China to the Communists in 1949 had a little to nothing to do with the fall of China on the part of the Chinese Communists. But the great racism in air travel through the years has made the airline a very profitable venture.

Cathay Pacific has had no groundcrew men, runs a very tight, small organization. The efficiency of Bellfield

and British long route in China trade has been transferred to the airline, and no unnecessary expenses are allowed. For example, Cathay Pacific, while inspecting International Air Transport Association firms, has never paid.

The last leg out of Hong Kong to Manila, British Airways, Singapore, Malaia, Lao, South Vietnam, Cambodia, Thailand, Burma, and into Calcutta to India. It has rights to Indonesia and Australia but has never exercised either. Unruhu National Air

was one of the first shareholders in the company but control of the old Cathay Pacific was relinquished to the hands of Bellfield and Seine, as well as the new company. With the merger, it now picks up Hong Kong Airways routes to Manila, Tokyo, Taiwan, Korea, etc.

Last year the airline earned 43,870 passengers as compared with 45,070 the year before and 47,618 in 1956. The load factor over all routes for the year was 68.5%.

National Plans Route Pattern Expansion

By L. L. Doty

Munich-Signed by its success with Boeing 707-120 turboprop operations, National Airlines is laying its future plans for jet service begin Dec. 15—first flight was conducted at Philadelphia because of weather at Idlewild and an initial flight was rescheduled at Baltimore, for mechanical reason, calling for a nonstop flight to Chicago.

According to Walter S. Stroh, senior vice president traffic sales and public relations, the Boeing 707 aircraft has a "spectacular" success according to National officials. Load factor has held consistently at a strong 92%. Only two flights have landed short of destination since service began Dec. 15—first flight was canceled at Philadelphia because of weather at Idlewild and an initial flight was rescheduled at Baltimore, for mechanical reason, calling for a nonstop flight to Chicago.

The carrier's current equipment program is designed to west the needs of the fast-growing New York-Bahamas market while preserving long-haul and short-haul flights in serving only a market at a northern transcontinental route. National hopes to add this let's route to its system as an ideal fit to the rapidly typical of coast traffic.

Here is National's future equipment program as outlined by Aviation Week's L. W. Dowdell, vice president of operations:

- Acquisition lease agreement with Pan American World Airways will provide National with either a Boeing 707-120 or Douglas DC-8 turboprop aircraft to start to cancel the loan from Florida state from December 1960 to April. Period of the lease is 18 years (AWW Sept. 15, p. 38).

- Fleet of three Douglas DC-8 turboprops, scheduled for delivery next year, will add the carrier's total long-haul needs. Total of 23 Lockheed Electras turboprops with delivery beginning April, will serve the off-shore Islands market and carry all medium-haul operations. National will purchase and maintain these aircraft.

- National will retain its fleet of Douglas DC-7s to supplement the Electra operations. Service considerations being given to the conversion of the DC-7s to turboprop power.
- Carrier plans to dispose of its 17 Convair 440s once the turboprop fleet has fully integrated into the system. Convair 440s and DC-8s probably will be retained to handle short-haul requirements.

To date, experience with the Boeing 707-120 operated under a short-term lease with Pan American has proved to

Malayan Airways which recently had to abandon its Singapore-Kuala Lumpur-Hong Kong flights, is a combination of local capital and BOAC and would fit neatly into the new carrier. Cathay Pacific Hong Kong, perhaps.

Such a regional carrier will find an opportunity to profit in the area with BOAC having its legal connections into Hong Kong through Indo-China and Far Eastern Airlines hoping to get more Pacific traffic operating below the end of the year.

space opening prospects. However, the carrier is never looking for the dark side of squalls, lightning strikes and bad weather problems of transoceanic aircraft.

Demand and transoceanic passengers at Miami, as scheduled at one hour and 15 min. Transoceanic which includes cabin cleaning, ground maintenance and refueling as normally completed self under the established time, although cleaning each route has increased a fair amount of the flight time. Despite this, light-colored fibers Pan American is looking for the services. National does not ordinate an engine overhead work on the Boeing.

Strohberg has selected a number of contractors against the three-bladed seating configuration of the Pan American Boeing 707s. Seats have been secured. The aircraft is designed with a North Atlantic economy-class three-abreast seating configuration with a full-service section and an eight-seat passenger lounge.

All seats are built leatherette seats with headrests, two abreast seats and four of the lounge seats have \$10.00 seats. Federal Aviation Agency is checking such negotiations to determine whether passengers can be seated in lounge seats which may not provide sufficient back support during landing and takeoffs.

Strohberg has handled an equipment acquisition by a letter explaining that National's desire to implement the intra-division of turboprop service on the New York-Miami route joined the carrier to use the Pan American Boeing 707s. Federal Aviation Agency is checking such negotiations to determine whether passengers can be seated in lounge seats which may not provide sufficient back support during landing and takeoffs.

Parakal, explaining the seating configuration in a double deck are now distributed as all jet flights. Strohberg has turned the 120 into a large segment of quality service and is not an adjunct of a substantial fare on route. In fact National is the only U.S. airline which has not applied for a fare increase, as the Civil Aeronautics Board General Passenger Fare Encouragement.

He told *Aviation Week*, he would

like to see the elimination of the 10% government transportation tax with fares increased by that amount if the tax was not increased at all and added:

"The relative position of the airlines in the transpacific field holds stronger at one price than low base costs of rail, bus, automobile and even plane leather container to climb."

A. G. Head, senior vice president in Washington, later added this plan coupled with the fact that airfares have kept pace with cost and "it would go to the carriers off the carrier's seat by increasing the price of fares."

Steiberg is not supporting lower fares. In fact, he does not necessarily endorse proportional fares but believes that the best way to generate air traffic and develop new markets is through dependency of service. He wants to see schedules operated with "adequate regularity" as a major step toward building up load sheet load and adding more computer traffic—a market he believes has come along.

Steiberg believes there is no market for an IATA operation which could cause passenger traffic delays. He anticipates that over time savings should be easily offset by the cost of putting the regularity of operation he feels is necessary before airline seats on its transpacific aircraft.

In addition, he prefers to use the development of such programs as "fly-drive" campaigns to partly compensate passengers from the private automobile

other than to employ promotional, cut-rate type fares to entice air traffic.

National Airlines reported a net profit of \$1,365,941 for the three months ended Dec. 31 compared to a \$679,560 net loss incurred during the same period in 1957. An analysis of operating revenues from \$9.9 million during the last three months of 1957 to \$18.5 million for the same period in 1958 is attributed to the 37.5% strike that National had at the fall of 1957 and the strike that grounded Pan Am late last year.

Total assets of the company as of Dec. 31 reached \$74.7 million as compared with \$59.4 million in 1957. The sharp rise is reflected in the investment and spend funds due to the company's higher share. This sum declined from \$4.7 million to \$2.1 million as the result of the exchange of 400,000 shares of capitalization stock with Pan American at a value of \$22.50 a share.

The friends, however, can not be expected to follow the Pan American lead because the British and Hong Kong may do the same. They will contend that the service was renegotiated in 1947 after rehire was filed under section 4C—see 4B of the bilateral agreement. Section 4C calls for the practice of exchange of information between the two countries on routes and services, not setting about additional steps.

Two days after the Pan American service began, the British did question Pan American's right to serve Hong Kong but made no move to stop the service. Northwest Airlines, which also is a signatory to the bilateral agreement to Hong Kong, as far as Pan American has now advised British officials to serve Hong Kong on a scheduled basis.

Comments throughout the industry is that the British government will consider that Tokio is to be granted BOAC as it is an integral bone since Pan American is already serving Tokyo, a major traffic point on the transpacific route.

As far as now stands, Northwest is the only intervenor in the proceedings. Last week the Air Transport Association is seeking a legal interpretation as to whether it has the right to curtail traffic at Tokio or suspending service for U.S. between points within the U.S.

BOAC has opposed both proposals. The airline is contending that it has the right to serve Tokio because of an exchange of notes between the U.S. and British delegations following the signing of the bilateral pact between the two countries in March, 1957, and the supplemental agreements are unaffected.

U.S. carriers are holding that BOAC can add a new stop to its present route only through section 4B of the bilateral agreement which states, in effect, that

BOAC Far East Route Proposal Draws Protest of U.S. Carriers

Washington—Plans of British Overseas Airways Corp. to introduce nonstop service from New York and San Francisco to Honolulu and Tokio are drawing immediate protest from the domestic air carriers.

Strong opposition to the BOAC move comes from an application by the route to the Civil Aeronautics Board for an amendment to its license as carrier permit to include Tokio on its route from Hong Kong to San Francisco and New York. Operation of the new service is scheduled to begin April 1 if the Board approves the application—which close the final day in BOAC's annual world route.

It is the opinion of the U.S. carriers specifically to the proposal of BOAC's transpacific service that either the proposed Tokio stop—During the Board pressuring conference in the case last week, Northwest Airlines proposed that the Tokio stop be exempted but that the Tokio stop be temporarily "waived" from the case

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other carriers may add intermediate stops in existing routes if the other carrier is so informed of the action.

However, both the U.S. and the United Kingdom have agreed in the past that "intermediate" point implies a "inner limit" point in the sense, U.S. carriers are charging that Tokio is the longest run in the world, is hardly a "route" stop. In addition, the carriers claim that, since Tokio is 1,500 mi off BOAC's direct flight route, it is hardly an "intermediate" point.

The British government official then, came in a letter sent to the State Dept. on Jan. 22, 1957, by the civil air attaché of the British Embassy here. The letter said some of BOAC's intention of inaugurating the transpacific service and, at the same time, it reflected its interpretation of section 4B to mean that no intermediate stops are a "route" traffic point.

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707 Drops Engine in Test Flight

By Robert H. Cook

Washington—Problems of the Boeing 707-120 assumed last night with the in-flight loss of a right sideboard engine from The American World Airways aircraft during a transoceanic test flight.

Loss of the engine resulted in the aircraft's maximum speed of 39,000 ft in dive rate of 3,000 ft per second.

The aircraft was flying at 39,000 ft in dive rate of 3,000 ft per second when the engine lost power. The aircraft's maximum speed of 39,000 ft in dive rate of 3,000 ft per second.

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Brian Broder, FAA representative in Paris

Comments yesterday in Paris, France, on demonstrating transoceanic control speeds at 39,000 ft under the airline's planned training program where the flight deck is located at 39,000 ft in dive rate of 3,000 ft per second.

The plane left 7,000 ft off altitude and the rate of the recovery maneuver to lose the engine and pod impacting from the aircraft's altitude.

According to normal flight speed and altitude and altitude with difficulty, and the aircraft was flown to London where more complete maintenance facilities are available.

Fell in Feature

PAA later reported that the engine was recovered in a gesture near the village of Pauilles on the River Dordogne. The engine was found in the river, the engine was recovered, but again spokesman expert their examination to settle questions of possible engine malfunction, with as possible turbine seizure, or whether the accident resulted from an engine failure.

Although the investigation is in its early stages with both CAR and CAB representation in London and Paris, Pan American Board to co-operate the transoceanic route research and development studies should result in the final investigation could provide information on both a strengths of engine components and a change in design of engine manufacture, according to PAA officials.

Racing Aircraft Co. made no particular comment on the accident other than that its field representatives in London are working with Pan American on the case.

CAB Aeronautics Board has entirely completed a technical examination of autopilot components submitted by the European carrier, Pan American. The report is expected to be made available Monday to airlines both under conditions and manner have been National's pt schedules.

Loss of the engine on Pan American's training flight took place while two of the airline's captains were undergoing a check flight, right wing or a company check pilot, a flight engineer and a Pan Am Airlines Agency sales adviser. The crew included instructor pilot Capt. John W. Ryan, Captain John M. Mattox and Edward M. Cane, flight engineer Herbert C. Seligman, and

Due to the unusual circumstances arising from an engine of the aircraft and engine was the decision by Pan American that its impacted jet was itself itself radioactive. Radiologists of the Department of Health, Education and Welfare were summoned to the aircraft after U.S. Customs agents in New York reported that company members were bringing from Japan a sample of the aircraft Gardner had picked up a radioisotope count in their pilot plants. Get ready to get picked up markings from the aircraft's exhaust.

Spokesmen for the government department and radiologists on the ground Boeing were not "significantly higher than allowable" but very higher than found on the number of jet aircraft's jet fuel. Source of the contamination can not readily determined, but at least some of it was attributed to the jet's high altitude flying in a region noted to contain many aluminum structures of the aircraft provides ultimate protection against that amount of radiation, they said.

Transpacific Case Ordered Reopened

Washington—White House, for the second time since 1958, has ordered Pan American Board to reopen the transpacific transpacific route research and development case to assessors Pan American World Airways bid to fly the North Pacific route. On the previous occasion, the White House in former CAA removed the case.

CAB majority recommended that Pan American be given the U.S. to Tokio in the central Pacific and Northeast Orient Airlines from the U.S. to Tokio via the North Pacific, both on a transpacific basis.

In the 1954 review case, Pan American applied to serve the North Pacific route in the Central Pacific, this was turned down by the Board, which stated in its original recommendation that "White House" was well advised in 1954 of Administration's desire to reopen the case reopened. Again the CAB's findings correspond to an earlier recommendation. This time, the recommendations were approved by the White House, but one month later approval was withdrawn.

In reviewing reopening of the case again, the President said "I believe it is essential to having policy and administrative objectives that the entire Pacific route complex be considered as a whole by the CAB. Aeronautics Board is requesting the Board immediately to initiate proceedings to implement all of Pan Am's route network in a single review and give me its recommendations at the earliest practicable date."

AIRLINE OBSERVER

► Pan American World Airways and American Airlines are installing the maximum allowable number of Boeing 747 freight transports in addition to the short-type aircraft already in service. Modification of the aircraft by Federal Aviation Agency order allows a request by American for permission to take the change. Earlier, Eastern Air Lines added the three-pod alternative to their Lockheed Electra in order to fit FAA operating authorities on the turboprop (AW Feb. 16, p. 30).

► American Airlines' gross passenger revenues increased 4.7% last year over 1979, but business fell 2.3% short of the carrier's established quota for the year. Air travel plus sales climbed 10%, military air traffic increased 6.8% and soft government air travel was up 8.3%.

► Reasons or tendencies are complicating that Aeroflot has incorporated new local routes without adequate programs. Flight often begin as soon as routes are study, but before commercialization, another station and passenger facilities are completed. As a result, trip cancellation are frequent, local factors drop as passenger turn back to surface transportation and the long lines increase. Aeroflot admits that poor performance, resulting from unreliable service, has forced the abandonment of several new routes.

► Boeing is now selling a 707 freighter transport off its Renton, Wash., final assembly line every three and a half days. Quantas Flying Services' first long-range 707 was rolled off the line with the second Quantas 707 already meeting the final assembly. American Airlines' 12th and fifth 707 will yet follow the first Quantas aircraft. British Overseas Airways Corp.'s first 707-420 powered by Rolls-Royce Avon engines is at No. 7 position on the current assembly line and scheduled for delivery in November.

► Lockheed Aircraft Service has delivered a Boeing 707 freight system training panel to American Airlines for use in introducing maintenance and ground personnel in the tracking and fueling methods of the freighter transport. Panel is electronically adjustable and reproduces the complete system as it appears on the aircraft.

► Russia is preparing to place its twin-turboshaft Yak-24 helicopter in commercial passenger service with an opposed V-1200 cabin configuration. First exhibited at the 1981 Tashkent Air Show, the Yak-24 has been thoroughly tested by Russia's military services.

► Pacific Air Lines will place the first of its six 41-passenger Fairchild F-27 turboprop transports into service in May as the high-density routes between Portland, Los Angeles and Las Vegas.

► Southern and Western Airlines are installing a cargo handling in a regular crew member on all fully transatlantic flights. Called loadmasters, the new crew members will be responsible for supervising loading and unloading, storing and readjusting of cargo and weight and balance processes.

► Delta Air Lines is distributing throughout the company a jet planning manual that details sensible progress in procurement, receipt, processing and clearing of all business, loading equipment, parts and parts for its fleet of Douglas DC-10 cargo transports. The 25-page schedule is revised constantly, records work accomplished and budget data for future plans.

► Federal Aviation Agency will open a new dual airway system between Washington and Richmond to ease the present traffic bottleneck on routes to the south from Washington. New airways have been made possible by reduction of some plus the joint use of a restricted area over U.S. Navy Proving Ground at Dahlgren, Va., and joint use of restricted area over Army Camp A.P. Hill, Va.

SHORTLINES

► Alitalia will extend its routes on May 4 to include Kunming and Bombay with two round-trip each week from Rome. The flights, to be operated with Douglas DC-10 aircraft, will leave Roma Wednesday and Saturday for the far East cities.

► Continental Air Lines' Sino air-cargoed 46,100,000 metric passenger miles in January for a 4.6% increase over January, 1978. Airlines also flew 1,316,000 metric tonnage miles, an increase of 2.5% over the 1978 figure. During the month, Continental flew 19,000 air freight ton-miles, up 8%; 10,000 air mail ton-miles, up 15%; 45,000 air express ton-miles, down 7%.

► Flying Tiger Line reports that net income and special items totaled \$12,210,574 for the six weeks ending Dec. 31, 1981, compared with \$11,150,000 for the same period in 1980, a 10.12% year-to-year increase. Operating expenses for the first half of 1981 were \$88,925,564 and operating expenses of \$86,373,396 produced a net operating income of \$2,546,668 before taxes.

► Lake Central Airlines' 1981 net profit totaled \$81,993 as opposed to a net loss of \$122,188 for 1980. Gross revenue for the year were \$53,996,238, a 19.8% increase over 1980, operating expenses were \$48,877,097, up 9.7%. Net working profit for the year was \$419,112, a \$119,832 boost over 1980 while the owners showed an operating loss of \$4,000. Total assets increased from \$19.5 million in 1980 to \$20.06 in 1981, up 15.5% over 1980. Total available net assets increased 18.6% to \$44,080,000. Over-all leverage load factor figure for 1980 was 45.4% as compared with 41.5% in 1981. Lake Central also has purchased two additional Douglas DC-3 aircraft from Transair Airlines at an undisclosed price.

► Luftthansa German Airlines is scheduling its first transatlantic all-cargo flights for May 8 using the first of its new aircraft, Lockheed Super-III Constellations, a freighter aircraft. Two round trip flights per week between New York and Frankfurt are planned.

► Pakistan International Airlines has renamed the East of Asia Vulcan Viscount 815 aircraft an aileron and is flying the aircraft on the carrier's Karachi-Delhi-Karachi route.

► Sabena Belgian World Airlines carried a total of 954,650 passengers during 1980, a 19.1% increase over 1979.

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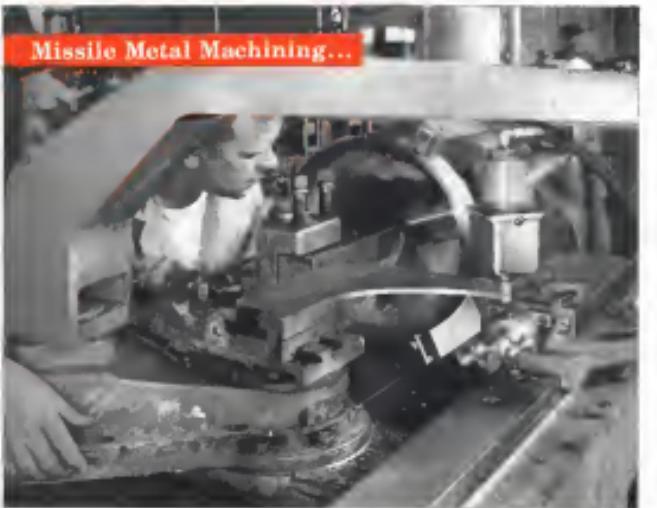
the question was: Would the steel



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Missile Metal Machining...



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The Diversy machine above is machining the inner diameter of a forward bulkhead of the Hawk missile to a fine 60 inchinch finish. Notice the precision curved template in the center of the picture with the follower at the right and transferring the contour to the interior of the bulkhead. Another good example of the Diversy air gauge tracer like techniques that has brought the aircraft hardware field to such an advanced state.

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Short Brothers Designs Britannic As Low Cost Strategic Freighter

London-Low development costs, simplified spans and maintenance requirements and short flight and ground run turning periods are cited in Short Brothers & Harland as advantages of the Britannic strategic freighter ordered for the Royal Air Force (AW Feb. 10, p. 15).

Using the same wing, tailplane, empennage, flight deck, and fuselage as the Bristol Britannic but with a fuselage diameter nearly 50% larger, the

freighter version will implement the Britannic 251 from transport now going into service with the Royal Air Force.

Fuselage of the Britannic has a width of 17.5 ft. and is 114 ft. 9 in. long, using a short freight hold 12 ft. square over a forward 10 ft. section and a stepped rear section 17 ft. high reducing the height of the rear section to allow engine access. Faired with the Douglas C-47, Short says

"The Britannic is based on the Britannic

sun 310 series and comes at the same speed of 360 mph. Wings are unchanged with the exception of a 10 ft. longer span to meet the increase in gross weight from 155,000 lb. to 165,000 lb.

Maximum landing weight of 165,000 lb. is up 21%, but the undercarriage remains basically unchanged.

The fuselage is pressurized to 8 psi, and retains the same tail unit as the Britannic 251 but adopts a "bowtie" design layout for freight dropping of large stores. The cargo deck is 10,200 sq. ft. giving a load of 5,000 lbs.

Cargo distance over the latest version of the Britannic is 3,000 miles. Normal accommodation of 140 passengers can be increased to 200 in. Cargo is quickly detachable, second floor at the forward end of the fuselage.

Short Brothers hope to exploit the low cost, long distance fuel sparing potential of the Britannic after 1963. As a passenger transport, the experts predict over 800 air distances up to 2,600 nm in 197 passengers.

Most of the sun 310 ft. length of the freight compartment is flat and level. The rear 20 ft. ramp portion stages could be used for loading as well as carrying freight. The ramp is powered hydraulically.

Smaller freight is loaded in a side door 7 ft. 4 1/2 in. 8 ft. at the forward end of the hold.

A loading grid can take up to 10,000 lb. gross loads on the floor and 2,000 lb. loads on the walls. Special load points are provided for 75,000 lb. gross weight.

Morane-Saulnier Laying Off 600

Paris-Nord Morane-Saulnier, unable to get funding for new projects, is now under government contract to those in prototype. Orders in the Paris area and lev 100 workers.

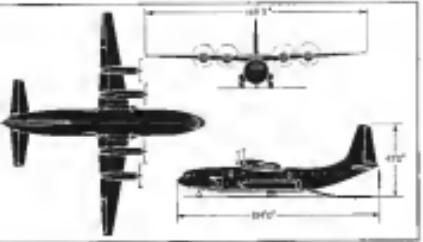
Contract probably will consolidate its operations at Tarbes in the south west of France where it is building its first plane MS 760 transport aircraft.

French aircraft industry officials are undergoing considerable difficulties as oil inflation is taking its toll and there are orders placed. The government apparently is working on a new five year plan which will give the industry a better idea of what is expected of it in the future. Industry observers are sure the plan will require considerable consolidation of present facilities as well as liquidation of some companies.

Morane-Saulnier currently has an order from the French Air Force for 50 military versions of the MS 760 Agrio, which also is being built and building number 45. The company also has sold about one-third of the end version.

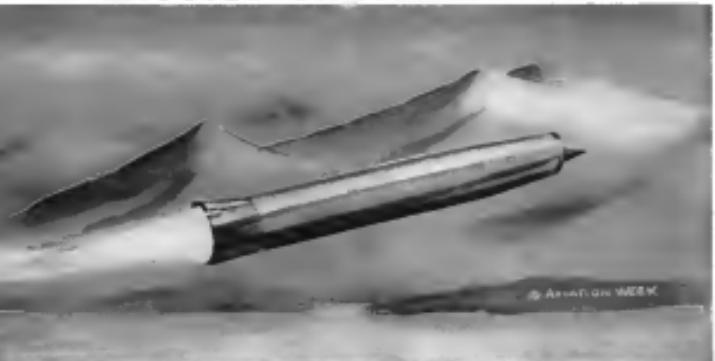


ARTISTS conception of Short Brothers & Harland Britannic 251 drooping strategic freighter shows relationship to Britannic 251 configuration. Flying, however, is 17 ft. 6 in. longer (AW Feb. 10, p. 15). Company and Britannic can carry a maximum payload of 75,000 lb. at speed of 360 mph for 1,600 nm. Aircraft, powered by four Rolls-Royce Tyne engines, has gross weight of 165,000 lb.



FUSELAGE of the Short Brothers & Harland Britannic 251 a diameter of 17.5 ft. and is 114 ft. long. Cross section cell volume is comparable to that of the Douglas C-47.

MISSILE ENGINEERING



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RAMJET weapon system with virtually unlimited range and a large payload which would use the rocket motor being developed in Project Pluto has been described to the Congress in some detail by Atomic Energy Commission and military personnel. An artist's cutaway of these descriptions is shown above. It would largely avoid ground-based detection by flying low and may even use air defense systems which are relatively concentrated along the few strategic attack routes which are possible with chemical fueled missiles. Vehicle systems which are relatively concentrated along the few strategic attack routes which are possible with chemical fueled missiles. Vehicle systems which are relatively concentrated along the few strategic attack routes which are possible with chemical fueled missiles. Vehicle systems which are relatively concentrated along the few strategic attack routes which are possible with chemical fueled missiles.

Lack of Engineering Data Delays Nuclear

By J. S. Bain, Jr.

Washington.—A nuclear missile can be built with today's knowledge and technology.

"It is just a matter of do you want it or not," according to Dr. Theodore Maiman of the Atomic Energy Commission's Los Alamos Scientific Laboratory who has technical direction of Project Pluto, the U.S. nuclear missile program.

Present materials are adequate for use in all parts of a nuclear weapon, and as operational aerospace vehicles can be constructed. This has been made clear in congressional testimony by Dr. Maiman and Air Force Col. Jack L. Armstrong, director of the Air Force Research Institute of AEC's Division of Reactor Development.

The U.S. nuclear missile program, however, apparently is stalled in a dilemma facing most U.S. development projects which are said to be completely feasible and within the intent of the law, but cannot proceed without the use of nuclear weapons.

The main reason is to go beyond the theoretical and laboratory test stages and build large scale test vehicles. This is delayed because concrete engineering data is not at hand to absolutely prove

feasibility. Most engineers agree that feasibility can never be conclusively proven until the problems involved in these large scale first vehicles are met and solved and that an amount of theoretical and laboratory work can circumvent the cost and time of engineering development.

Project Pluto is now in the midst of proving the feasibility of the nuclear weapon.

Very II is the first complete reactor that will be tested by Project Pluto. It is designed to prove, perhaps now, that a nuclear reactor can be built. Other reactors will follow. Very II is proof that the manufacturing of a full scale reactor for a missile can be successfully constructed.

The funding that has been available

to accomplish prove feasibility has been extremely modest, as are stand alone which might be applied radio to low level development work. In 1958, Gorton-Wright and Atomic Energy Commission received small AEC contracts to study the problems associated with nuclear reactors. In 1957, the amount of money was greatly increased, and \$45 million was made available for the project.

By that time, the project had pro-

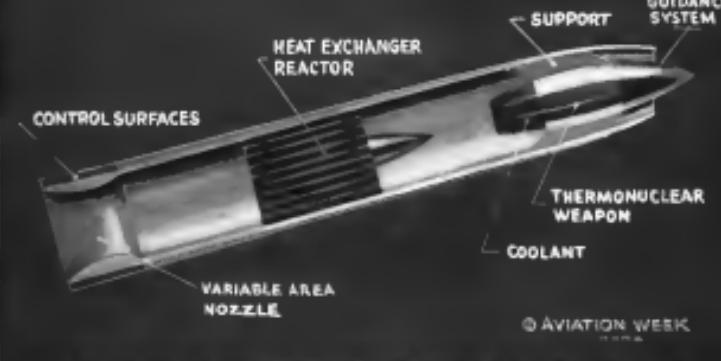
gressed to the point where more expensive work was needed, and it was impossible to bring two contractors into an agreement acceptable with the money available. The bulk of Gorton-Wright's work was thus terminated. It was financially possible, however, to have more people at the Los Alamos Laboratories dedicated to Project Pluto because they could no longer be supported by Project Rover, the nuclear rocket program.

AEC Request

In 1958, the AEC requested \$10 million in operating money for Project Pluto, but the request was cut in half by the Administration. An additional \$2.5 million request for construction was allowed.

The AEC in 1959 requested only \$7 million in operating funds for the project because its level of activity in 1958 had been such that it could not effectively use more money. Construction appropriations in 1959 were, as requested, \$6.5 million.

Additional money was appropriated by Congress in 1958 and 1959 in the amount of Project Pluto officially. The total supplemental approved was \$3 million in fiscal 1959.



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GENERAL layout of the nuclear missile vehicle are outlined in cutaway drawing. An artist's conception of the equipment is shown above. Apparently the guidance system, thermonuclear weapon, control surfaces and other auxiliary equipment would be housed in the outer body of the missile. The reactor would replace the combustion chamber in the chemical fuel missile. Four movable nozzles on the off end of the missile body would provide control. Some type of variable geometry air intake and exit nozzle system would probably be provided to allow rapid altitude changes and maneuvering.

Ramjet

Dr. W. Kenneth Davis, director of the AEC's Reactor Development Division, gave an outline during congressional hearings into the methods used to determine the amount of money the Administration will allow for AEC programs. Dr. Davis said:

"Under current circumstances from the

status of the Budget and after review by the commission we were, in effect, told that we should keep this program [Project Pluto] at the same level in 1959 as it was in '58."

Dr. Davis also said that the budget for the reactor division was held to a specified level by the Administration with instructions that this figure would not be raised unless some compelling reason was given for increasing it. He also indicated that the advice of the

people in charge of each project was taken into account when the AEC divided the funds allotted to it.

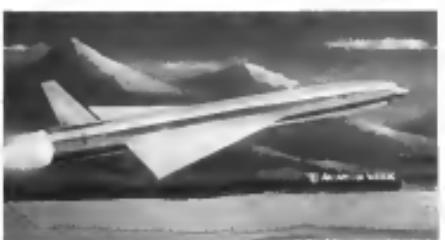
However, Dr. Davis added, "In this particular instance [Project Pluto], it is felt that the amount of money which we were finally able to put into that was not equal to what the laboratories thought they could do."

AEC funds are only part of those that are being expended towards producing a workable nuclear ramjet vehicle. Air Force is conducting programs to provide diffusers and nozzles that would be necessary to make a complete weapon system using the nuclear AEC in developing. All of the nuclear work including the very earliest efforts of reactors and high temperature air turbines is carried in the AEC program.

Operational Vehicle

The operational vehicle that would result from this effort by Project Pluto and the Air Force has been described as length by several missile experts and project officials. An Air Force Gen. Donald J. Keane, chief of the Air Force Research Branch of AEC's Reactor Development Division, has discussed the newer version of the vehicle in the following terms:

* It would have the highest payload to gross weight ratio of any intercontinental strategic missile, giving it a relatively



WHIGDE version of the missile project might be desirable for certain mission requirements. However, at most Mach numbers lifting about an unshielded nuclear bodies such as this one are high enough to allow a large payload to be carried and provide adequate maneuvering capability. High maneuvering requirements limit Mach 2 might necessitate wings but they would increase the cooling problem at higher speeds.



Vanguard II Satellite and Instrumentation

Vanguard II weather reconnaissance satellite (AV Feb. 23 p. 31) is assembled (left) at AstroInstrumentation Branch, U.S. Army Signal Research and Development Laboratory. Acoustic instrumentation is tested in shaker in cylinder before being mounted on satellite.

low one for the amount of electron power delivered.

+Such a missile could penetrate at supersonic speeds for certain ranges at low levels, if dived, and since it would be aerodynamically controlled, it could change direction and altitude. By using conventional nuclear guidance techniques during all portions of a mission, excellent weapon delivery accuracies are possible.

Col. Armstrong has identified an congressional testimony as an unassisted vehicle which would not have severe shielding problems. He also described it as having enhanced range but qualified his statement by adding: "While I am interested in range, actually I am not talking about it going far or anything of the kind, only that it is relatively a tight maneuver. So this means that quite considerable payloads can be carried."

Dr. Merkle described the contamination problem as being so small that the missile could be well designed, be transported around the country on a truck trailer, and launched from almost any open field. Large boosters would be used to take the missile to the speed for a nuclear range to take advantage of the speed for a nuclear range.

Guidance for the vehicle could be provided by use of several known systems. Col. Armstrong has mentioned, among others, a combination of inertial and map-matching various factors that would provide considerably more accuracy in the intercontinental delivery of weapons than is possible with ballistic missiles.

One obvious benefit of the nuclear range's ability to travel great distances at low altitude would be a low level flight over an entire continent. Such a



flight would make ground-based detection systems potentially useless unless the missile passed almost directly overhead. Only surface detection systems at great height would be truly effective against such an attack.

A possible configuration for the nuclear range missile was outlined in Congress by Dr. Merkle. The reactor and necessary guidance and auxiliary equipment would be integrated onto the missile in such a manner that the capsule would be used as a flying powerplant. Dr. Merkle said:

"It is a core ranged missile. It is not faster at all. It is a kind of flying booster. The reactor portion is back here in the tail. Forward of the reactor is some insulation to keep the structure cool at the very high Mach number. Forward of that is the bomb compartment. Forward of that is the guidance equipment and the like. The structure that is the outer envelope can be built using coating technology. No new research is required there."

Such a missile probably would cruise somewhere between Mach 2 and 4 depending on altitude. Armstrong indicated that the National Advisory Committee for Aeronautics and other laboratories indicate that it is possible at these speeds to get acceptable lift/drag ratios using a wingless missile shape resembling a simple circular range missile. Above Mach 5, the lifting ratios of such vehicles are approximately equal to those of the best winged configurations.

At any rate, lifting ratios would not be critical for a vehicle with virtually unlimited range as they are for chemically fueled vehicles. Therefore, it is probable that the nuclear range missile

Control response required in the reactor section would be exact, but it is be-



Transistorizing missile flight control systems by Lockheed aerospace has exact significant reductions in weight and space requirements.

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Flight Controls offers one of the most challenging areas of work at Lockheed's Missiles and Space Division.

From concept to operation, the Division is capable of performing each step in research, development, engineering and manufacture of complex systems. Rapid progress is being made in this field to advance the state of the art in important missile and spacecraft projects under development at Lockheed.

Flight controls programs include: analysis of flight data and subsystems performance; design and packaging of flight control components; development of uninstrumented canisters; operation of specialized flight control test equipment; and fabrication of flight control prototypes. Other work deals with the design, development and testing of rate and linear gimbals,陀螺仪, servomechanisms, gyroscopes, computer assemblies, guidance control systems, electronics, and hydraulic systems and components.

In the flight controls simulation laboratory, mathematical representations of aircraft in a control system are replaced one by one with actual hardware to determine controllability of specific designs. From these studies, Lockheed obtains information which is used in further refinement and improvement of final control systems designs.

Lockheed Missiles and Space Division is weapons systems manager for such major long-term projects as the Navy Polaris ICBM, Discrete Satellites, Army Kingfisher, Air Force Q-5 and X-7, and other important research and development programs.

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One of Lockheed's test stands with dynamic thrust reaction to simulate flight environment.



CABLE and WIRE LEADS

by HOWARD C. PENNINGTON

Engineering reliability into cable assemblies



CABLE ASSEMBLY Pennington's TV is one of the stars of the reliability of communications, insulation, soldering, crimping and connectors. The TV transmitter is the most important part of the system; its expense is the largest percentage of total assembly failure.

Maintainability of electrical and electronic equipment is a major consideration in a missile system. Cable assemblies must be highly reliable if the test of cause failures. Reliability, insulation, soldering, crimping and connectors, are critical in reliability of the system. Breakout or poor contact under shock and vibration, ground or corrosion are major causes.

One addition has to choose protection areas for each component manufacturer's circuit design, code manufacturers, connector supplier and whatever is necessary to make the system reliable before specifications are written. Thereafter, apply multiple responsibility and design, design and destroy.

There's a better way. Reduce your costs by reducing the number of parts you make. If you're a small manufacturer qualified and assigned to support complex responsibility, like Corporeal, don't do it alone.

How about standard parts? You specify shortest mechanical, functional, environmental requirements. From there on, the responsibility is a manufacturer's job. We can't afford to let insulation, proper lay of wires to achieve skin damage, cable insulation, flexibility and use. We really want to make sure that the cable never plied or tinned. We also stress standard or maximum special insulation, no sharp edges and so forth. Finally, we want to make sure that the prototype does your assignment. Prototype approved, we provide you with an initial production quantity. The result will be reliable assemblies at low cost, at least cost.

Pennington? As a manufacturer of wire and cable for aviation and military applications since 1928, Corporeal has the experience and ability to work with you. For technical assistance or information leading to reliable cable assemblies, write:

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Constant Review

Washington—Project Photo has been under review by some form of committee or evaluation board during most of its existence, according to An F-105 Test Project Manager of the Strategic Air Command Board of the Air Force Materiel Agency's Division of Research, Development and Engineering.

Col. Anthony believes that project review by committee experts is basically a sound plan and could be improved if material, but he also feels that the present methods fall short in these areas:

- **Facture review** should be limited or discontinued to keep from using too much of the time of project personnel the hearings and presentations to the reviewing group.
- **Reviewing committees** should include experts in every phase of the activity in development that they are reviewing. This is rarely ever done, he says, and such committees tend to concentrate on the particular panel that they know best. They should often frequently consult with those of other committees which had to deal previously with another segment of the total problem.
- **Committee members** should be used as serial visiting judges at one-time hearings holding down one or more preselected positions. This does not provide them with sufficient time to review all projects.

• **Reviewing committees** should have authority to give advice only rather than to substantially change the process of any project.

- **Reports** by reviewing committees should be shown to the project which are reviewed before they are released. This would allow correction of any misunderstanding of fact by the reviewing committee before the issuance of the report.

Levitt by Project Photo personnel to be within the state of the art. Since this is passing through the project manager as a costliest for the reactor as well as the power plant for producing heat, the power plant object the power level quickly as the vehicle changes altitude, and the density of the coolant gas changes. A controllable valve and nozzle on the reactor would quickly reduce the power change experienced upon the change in altitude.

A hot critical assembly building is located adjacent to the control building. Nuclear physics experiments will take place there, primarily to determine the critical mass of plutonium in selected transports. At present, expert knowledge of criticality has been gained at some laboratories or slightly above.

The present reactor development effort in Project Photo is directed at three principal directions—nuclear, nuclear physics and mechanical engineering. Numerous improvements are made by Dr. Meissle as long as his basic design is kept.

Meissle has been doing these tests will show if there is a reason to do several at high temperatures. While this is a conservative trend, it is not certain that the reactor's performance is close enough to what is expected.

This is similar to the situation existing in the flight testing of a number of aircraft in the past when they experienced unexpected aircraft reversal at various speeds and attitudes. It is possible that at certain temperatures the reactor control rods should be pulled out rather than pushed in to reduce power.

This experimental pile in the cutaway experiments does not become radioactive until after they can be performed due to the low power.

While cutaway on the Project Photo "A-1" is not as advanced as that in the nuclear rocket rods, the reactor itself is considered to be in a more advanced state, and was probably off much earlier than the nuclear reactor might believe that a workable nuclear reactor will produce the nuclear reactor

Missile Prepackaging May Soften Navy Resistance to Liquid Fuel

By RANDI HAWKIN

Problems. Cold-Prepared, reusable tanks of liquid rocket propellants and a throttle-controlled rocket with thrust precisely variable from zero to maximum have been developed by Naval Ordnance Test Station, China Lake, Calif.

The developments may soften Navy resistance to liquid propellants in missile missiles. NOTS engineers are encouraged they can be incorporated in weapon system development relatively soon.

The responsiveness of reusable liquid propellants and complete command control of thrust offers important advantages. Stabilized over the same quick start and altitude range. Specific impulse and thrust, while demonstrating performance comparable to that of rockets using liquid monolithic liquid propellant combustion.

NOTS will not identify the missile publications it has had success with but the ones which NOTS experts claim their "workshop" publications are perhaps, have been tested in aluminum containers for five years without de-formation of tanks and dropped 40 ft. into steel decks without serious damage. Navy crews have filled missile tanks of the workshop publications are highly resistant to impact shock and gunfire.

Revised Faster

The standards are more and highly conducive to liquid mass but NOTS studies indicate that these bonds are more easily extruded than expected. NOTS maintains that the proper criterion of stability is the boiling temperature of the propellant rather than viscosity or the effect upon launch being felt at different temperatures. In general, Al. rods, if broken point is extended, it may affect the properties of the propellant and its behavior during ignition of the rocket. Caussons is just added an easier problem because these always use tank material to be formed which is compatible with the propellant.

Cryogenic (liquid) gas oxidizers are also easily eliminated to the high boiling point requirement. Suitable propellant tanks must be designed to withstand heavy loads due to the propellant pressure applied to the container. Unusually important tanks can have aluminum walls as light as 0.1 in. thick.

NOTS throttle-controlled rocket aqueous hydrazine fuels which may include nitro and fluorine combustion as oxidants. There have been other

black listed 60 days and aside from the time spent in conserving the sites required a little over four months of labor. Blast of the hydrazine-powered system is a truck hauler rocket engine brought up to an orbit configuration. Something very similar to the experimental units could be delivered in about 550.

Compared conventional thrust engines it is possible for a missile in space days to achieve a near constant higher velocity without difficult programming of thrust termination if in orbit) small correction possible at end of burning.

Enter to a much wider range that a constant velocity of about 19,000 fpm be matched with a distance of about 4 ft. Command-controlled combustion would obviously improve the probability of a successful trip and would simplify guidance system by producing an improvement in reliability.

In a military missile the number of times of consumed normal and mobile liquid propellants can result in greater reliability and in missiles with longer range at greater payload for the same external dimensions.

Navy Plans Development Program For Polaris High-Yield Warhead

Washington—Navy program for development of a guided-missile warhead for the Polaris fleet ballistic missile with a three-stage solid propellant and light-weight warhead warheads that could be fired from gas or dropped from helicopters in anti-submarine warfare were outlined by Adm. Arleigh Burke, Chief of Naval Operations, to the Senate Foreign Relations Committee.

Adm. Burke stressed the submission that an intermediate form of nuclear weapons being world would mean a fusion of these programs and prevent their ultimate disengagement.

Greater Yield, Lesser Weight
"There are great prospects of increasing the yield and decreasing the size of weapons," Adm. Burke told the subcommittee. "In Polaris we have a intermediate field, but if the two were to combine, we could probably get a smaller head weighing the same amount which will have two or three times the penetration yield."

"Also, we would like to go into and small weapons-depth charges that could be fired from a gun, for example. Some day we will be able to achieve that if testing continues."

Although improvement conditions in warhead propellant and guidance, Adm. Burke said that the program will not

lire muscles and which have not been to blocking development of such weapons for submarine warfare. After Burke and that a ban on nuclear tests also would prevent the Navy from developing rapidly needed data on lethal uses of atomic weapon at sea. He explained:

"We still need to know the range at which a significant job would be rendered... We know the lethal range of an atomic weapon pretty well at various depths from our underwater tests, but we do not have enough data on how far our own ships should

be away from the explosion at ocean level to get maximum damage." Though data indicates range from explosion should be 2,800-3,000 yds, he said.

A seismic grenade device which could be fired from guns for antisubmarine warfare, Adm. Burke said, "would be a lot cheaper and easier" than the nuclear homing depth charge which Navy now has in the design stage. "What we are trying to do is develop a way to use our present gun platforms and fire control equipment without putting more expensive equipment in the ship," he commented.

Offshore Civil Aircraft Corridor Opened by Pacific Missile Range

Pt. Mugu, Calif.—Pacific Missile Range headquarters here has opened a corridor in its ancestral weapon-free zone for part-time use of transonic civil aircraft.

At Pacific Missile Range suggestion, Federal Aviation Agency has given the corridor a dual designation as a control area (C-76) and a warning zone (W-577). The range will try to build the long-awaited ground-based air traffic controllers and transonic flights will be cleared through corridor between flights.

The zone will be under the jurisdiction of the Los Angeles Air Route Traffic Control Center which would designate it a Whiting Area at Pacific Missile Range request.

The idea of dual designated airspace is not new but this is the first time it has been applied. Military and airlines men before its wider use would discuss its application and the present version of the system. The Pacific Missile Range dual designation was became effective Jan. 1.

Former Policy

For some time Pt. Mugu has been granting dual transit clearance to commercial carriers on request and denying clearance to military and defense aircraft until there was potential conflict with missile operations or when a clear flight path could not be guaranteed. This has been continued and is done on VFR, all intent requests have been granted.

An offshore surveillance radar network is an essential part of planned Pacific Missile Range entrepreneurship. The range, Air Defense Command and Federal Aviation Agency are working out ways to fit the network into the national Air Route Traffic Control system and make nearby ARTCC facilities available for special Pacific Missile Range missions. The range's equipment is being fitted with radars and used and all surveillance data will be

made available to Air Defense Command, Los Angeles ARTCC and anyone else who has a legitimate need for it.

Date relay systems being installed are designed so that other personnel will have access to the information, as much as control receivers and display units are installed. Pacific Missile Range has tried to make the system compatible with those planned by FAA and Air Defense Command.

Navy space-surviving fighters out of planned Naval Air Station, Lemoore, Calif., will cover out flying practice in Pacific Missile Range. To get this craft through the Monterey-Pepperdine area and within the boundaries of the range's primary control network, range controllers will have to make an early will-call data from FAA facilities to be handled at Pt. Mugu and Monterey. Federal Aviation Agency and its predecessor, Airways Modernization Board, and the PAF-BARTCC coordination plan, calling for dual designated airspace with an eye to fitting the user conflicts elsewhere in the empire.

A problem as yet unsolved by the range is the passage of unannounced civilian light aircraft through the range restricted area. At NMIC Pt. Mugu an average of three lightplanes a week pass through the traffic pattern which includes high performance jets and disease without warning. In the NMIC's contract to airbase, when the airport managers and even other contractors and potential customers have failed to do so, the range's Pacific Missile Range representatives, consider the supplier of the chart route to private pilots and to offering NMIC control facilities to qualifying aircraft, has recommended NMIC selected area (Re-180) to fit prominent landmarks and has placed a 3,000 ft. ceiling over military aircraft in the area.

NASA Contracts

Washington—Following a contract-by-contract breakdown of National Aeronautics and Space Administration annual and development contracts of over \$50,000 let from the organization of NASA on Oct. 1, 1953, through Jan. 31, 1968, the dollar figure given represents the total amount of a service item. It represents the total amount of dollars due on the contract, which in some cases will extend over several years.

NASA Headquarters

California Institute of Technology, Jet Propulsion Laboratory, program aircraft research and development contracts of over \$100,000, let contract of research, contract number 380-41, \$4,000,000, \$8,100,000.

Naval Ordnance Test Station, White Oak, Maryland, Research, Study, Development, Design, Analysis, Consulting Services and Partial Testing in Support of Nuclear Warhead Development, Contract Number 381-41, \$1,000,000.

Naval Research and Development Command, Research, Development, Design, Analysis, and Production of Nuclear Warheads, Their Able Isotope Power Sources, Contract Number 382-41, \$1,000,000.

Army Ordnance, White Oak, Pennsylvania, Research, Development, Design, Analysis, and Production of Nuclear Warheads, Contract Number 383-41, \$1,000,000.

E. S. Research Department, National Bureau of Standards, Research, Development, Design, Analysis, and Production of Nuclear Warheads, Contract Number 384-41, \$1,000,000.

Allen Engineering Co., Research, Reliability, and Production of Nuclear Warheads, Contract Number 385-41, \$1,000,000.

U. S. Department of Defense, National Defense Research Commission, Research, Development, Design, Analysis, and Production of Nuclear Warheads, Contract Number 386-41, \$1,000,000.

State University, program, continuing investigations for space, earth and atmospheric sciences, Contract Number 387-41, \$1,000,000.

Naval Ordnance, White Oak, Maryland, Research, Development, Design, Analysis, and Production of Nuclear Warheads, Contract Number 388-41, \$1,000,000.

Naval Ordnance Research Foundation, Inc., Research, Development, Design, Analysis, and Production of Nuclear Warheads, Contract Number 389-41, \$1,000,000.

Office of Naval Research, Naval Ordnance Test Station, White Oak, Maryland, Research, Development, Design, Analysis, and Production of Nuclear Warheads, Contract Number 390-41, \$1,000,000.

Naval Ordnance Research Foundation, Inc., Research, Development, Design, Analysis, and Production of Nuclear Warheads, Contract Number 391-41, \$1,000,000.

Naval Ordnance, White Oak, Maryland, Research, Development, Design, Analysis, and Production of Nuclear Warheads, Contract Number 392-41, \$1,000,000.

California Institute of Technology, Jet Propulsion Laboratory, program, scientific investigation of the Earth and the Moon, Contract Number 393-41, \$1,000,000.

E. S. Research Department, National

[Continued on p. 53]

WHAT DOES IT TAKE TO BUILD MISSILE SYSTEMS?

IT TAKES all of the dynamic resources, technology and skilled man power of the entire defense complex—the best of the military, government and industry.

The staggering sum of \$33 billion was spent on missiles alone in 1968 and this level will continue, probably increase in the future.

How does a large diversified manufacturer participate in this highly sophisticated field,

earn acceptance as a qualified defense contractor? How does one integrate the work with normal business operations so that gains continue in company growth, in employment and in earnings?

Here, Minneapolis-Honeywell demonstrates the corporate weight it places against the biggest, most complex, and certainly the most expensive undertaking by our government in peacetime history.

WHAT DOES IT TAKE TO

HONEYWELL MANUFACTURING AND RESEARCH FACILITIES IN THE UNITED STATES, CANADA AND OVERSEAS

It Takes Corporate Strength

Honeywell Growth—Honeywell has a history of growth in the past ten years sales have increased from \$37.5 million in 1948 to \$325 million in 1968. Employment has increased from 9900 to 32,000 in the same period while net earnings have increased from \$5.9 million to \$22.6 million.

Strength from Profits—A vital factor in Honeywell's growth has been its consistently profitable operations coupled with conservative financial policies. This has enabled the company to plow back earnings \$96 million in the past ten years; readily obtain adequate financing.

Diversification—Honeywell is a diversified company. It manufactures 12,000 different products and sells to almost every industry. Yet the company is specialized in that it has chosen to stay within the general field of automation and data processing. Almost all of our products are of a precise, complex type with a high degree of engineering content—over half are electronic. With this product line it is not surprising that Honeywell, as the leading control manufacturer, should participate in a stable way in the more complex component and systems aspects of defense work.

HONEYWELL FACILITIES The 35 plants combined in the 11 facilities at right show Honeywell's manufacturing, engineering and research facilities brought together in one community. Not shown are the company's warehouses, smaller manufacturing plants, and 108 sales and service offices throughout the world.



1. Amsterdam, The Netherlands, Honeywell U. V. Temperature Control
2. Frankfurt, Germany, Honeywell U. K. & I. Europe
3. Stockholm, Sweden, Honeywell Brown Boveri AB, Honeywell instruments, MIDO SHUTTER switches and control devices
4. Atlanta, Georgia, Honeywell U. S. A. L. Temperature controls
5. Tokyo, Japan, Yamada Honeywell Manufacturing Company Ltd., industrial instruments, MIDO SHUTTER switches and control devices
6. Seattle, Washington, Electronics Division, electronic equipment
7. Los Angeles, Seattle Plant Gas appliances, controllers
8. Los Angeles, New York Division, electronic, power, heating systems and components
9. Los Angeles, Seattle Plant Roots systems and compressors
10. Chicago, Northern Div. Plant Temperature controls
11. Worcester, Research & Development Center, Corporate R&D research
12. Philadelphia, Industrial Division, industrial controls sales office
13. Philadelphia, Skys Plant Industrial instruments, valves

14. Everett, Wash. Plant 3, WDCO Service processor and controller, Fort Monmouth, New Jersey, Fort Monmouth, New Jersey, Fort Monmouth, New Jersey
15. Philadelphia, Lytton Plant, Industrial instruments, valves
16. Philadelphia, New Port Industrial instruments, controls
17. Toronto, Ontario, Honeywell Canada, Canadian Division, Canadian Division of Honeywell products in Canada
18. Melrose, Boston, Mass. Plant Transportation division
19. Newark, Indiana, Ford Diesel Power generation in streams
20. Phoenix, Arizona Plant Automation and control systems and computers
21. Idaho, Charles River Plant, Automation, motion systems, computers
22. Idaho, CANTACO Computer Division, electronic processing equipment
23. St. Paul, Minn. Plant, Automated heating center
24. Atlanta, Georgia, Honeywell Laboratories, Raytheon, Locomotive, aircraft, auto racing, data recording
25. Rochester, New Hampshire, Honeywell instruments
26. Paterson, N. J., Model ground support equipment
27. Paterson, N. J., Model ground support equipment
28. Paterson, N. J., Model ground support equipment

It Takes Organization

HEADED by a Group Vice President, the Military Products Group combines the experience and facilities of four of the company's divisions grouped to serve the military market with more effectiveness. These divisions are represented to the military by a single integrated sales force. The group is able at any time to draw on the Corporate Research Center and on other Honeywell divisions.

Integrated Divisions—The four major divisions incorporated into the Honeywell Military Products Group produce in excess of \$100,000,000, or 30% of the Company's sales. Their typical areas of activity are:

AERONAUTICAL DIVISION—located in Minneapolis, Minnesota; Los Angeles, California; St. Petersburg, Florida

Missile systems and components including inertial guidance systems, missile stabilization systems and components, advanced flight control systems and ground support equipment, bombing systems, electronic fuel measurement systems, engine control and instrumentation systems, precision gyro and other components.

BOSTON DIVISION—located in Boston, Massachusetts

Missile systems and components including gyro, accelerometers, synchros, proximity switches, servos, de-

modulators, instrumentation and telemetering equipment, amplifiers and other equipment for precision measurement and control.

MISSILE EQUIPMENT DIVISION—located in Pittsburgh, Pennsylvania

Ground support equipment for high pressure gas systems, cryogenic systems, programming equipment and simulators for functional checking of ground support systems.

ORDNANCE DIVISION—located in Minneapolis, Minnesota; Los Angeles, California and Seattle, Washington

Missile systems and components including fuses, safety and arming mechanisms, initiators, warheads, underwater ordnance and sensor systems, ground support equipment, fire control systems, infrared systems, communications equipment, and cryptographic equipment.

Capability in Depth—Today, Honeywell's Military Products Group includes a combined force in excess of 9,000 people—over 1,000 of whom are graduate engineers. Its engineering and production areas exceed one million square feet, with 16 factories and facilities in seven cities. The combined expertise and resources represented in this group make it one of the largest sources in the country for research, engineering and production capabilities for precision military electronics.



It Takes Experience

A DEPTH of experience along broad lines is available from the Military Products Group which presently has complete weapons system responsibility for several missile projects—two of which are an antisubmarine missile and an air-to-surface missile—with extensive experience in all phases of the programs, from research and development to final user tests.

Missile and Space Systems—With a notable background in missile and space systems management, as well as in system and component design, development and production, and testing, Honeywell has the capabilities, experience, personnel and facilities necessary for work with all phases of prime missile and space systems.

ANTISUBMARINE—The Ordnance Division has been under contract to the Navy's Bureau of Ordnance for the ASROC missile program since early in 1958. As a prime contractor, Honeywell has been responsible for systems acquisition, coordination and direction of all phases of the project including the missile, fire control, launcher, warhead, test, checkout, and training equipment. A special engineering branch at Los Angeles, California, has been established to promote liaison between Honeywell and the Naval Ordnance Test Station which has technical supervision of the project.

AIR-TO-GROUND MISSILE SYSTEM—The Antisubmarine Division entered into contract with the Air Force Antisubmarine Center in 1964 to develop, test, and produce initial quantities of a classified missile system, a program that parts out the Military Products Group's ability to function as a corporate team. As prime contractor, Honeywell's Aero Division has been responsible, respectively, in this program, which includes all phases of the missile development, including launch, missile storage and preflight checkout equipment, airborne storage and guidance system. The science warhead adoption kit is being handled by the Guidance Division; the propulsion system is sub-contracted.

SPACE FLIGHT CONTROL AND GUIDANCE—Honeywell is a member of the Merlin team for developing the Air Force's heat-glide aerospace craft called Dyna-Sat, and is conducting preliminary development analysis of certain classified control aspects for Dyna-Sat's polar orbital flight. Honeywell is also working directly with the National Aeronautics and Space Administration on the stabilization control of space vehicles. In this same field Honeywell is responsible for the stabilization control of McDonnell Aircraft's "Project Mercury" program.

SPACE ENVIRONMENT—Honeywell is currently working on a space capsule and its environment control systems. Drawing on the corporation's unmatched experience as the world's leading producer of environmental controls and systems, Honeywell engineers are developing a control system to maintain a hostile environment for a man in a capsule in space. This work involves

design of the complete system for cabin control and the modification and integration of components into a reliable, accurate system.

Missile Sub-Systems and Components—Honeywell's Military Products Group has been active in the design, development, production and testing of various sub-systems and components for a wide range of missiles which includes: Falcon, Little John, Sergeant, Thor, LaCrosse, Honest John, Corporal, Redstone, and Sidewinder, plus Atlas, Titan and Polaris, still under development.

Fiber optics in which the Group has distinguished itself are—Inertial Guidance Systems and components, including the gyro reference systems for Titan and Vanguard—Advanced Flight Control Systems, where we are the largest manufacturer—Instruments, including fuel measurement systems for all of America's jet transports—Fuzing and Arming Systems for many of our operational missiles—Warhead systems for such missiles as Honest John and Little John—and others; Safety and Position Guidance Systems—Test and Checkout equipment—Thermal Batteries and Power Supplies—Transtable Launchers—Ground Handling Equipment—Ground Support Equipment—Atlas Warhead Adapter Kits—Airframes—Telemetry—Transitions—Infrared Systems—Instruments—Computers—Sonar.

Much of the work in these fields has been directed toward research and development of better equipment to meet ever-changing missile parameters. The attitude of seriousness in research that grew with the Honeywell corporation is thoroughly instilled in the divisions of the Military Products Group, and this is one of the reasons why Honeywell has so rapidly moved to the front in space and guided missile work.

Specialized Techniques—In the extensive work done by the Military Products Group in all phases of missiles, special techniques had to be developed for nearly every segment of the various programs. In response to these special requirements, Honeywell engineers and technicians have mastered the necessary

techniques to the point that now many of them are routine. A partial list follows:

RELIABILITY TECHNIQUES—In obtaining accurate reliability figures for computers and systems life tests, chain law of probability ratio and other test methods are used. Honeywell has complete environmental laboratories, capable of performing all standard reliability qualification tests, and has had extensive experience in supersonic sled testing.

PRODUCTION TECHNIQUES—Honeywell Research and Production personnel are constantly experimenting with new production facilities and manufacturing standards using processes such as five axis machining, electron beam, induction, ultrasonic processing, accuracies of 1/2 millionths of an inch, exotic materials such as beryllium—and developing workable high-temperature compounds such as ceramics and ceramics.

INSTRUMENTATION, MANUFACTURER, FIGHTER DIVISION—For years the division of the Military Products Group has produced precision designs in these expert areas, and many proven components are produced for missiles incorporate Honeywell instrumentation, printed circuitry and technician techniques. These are uncompromised, as used by Honeywell's own production. Moreover, division, which includes Honeywell producing Transistor Division, which enables Honeywell to maintain quality control in the use of these solid-state electronic devices.

SPACE-FLIGHT REQUIREMENTS—In addition to advanced work in the more glamorous aspects of space flight, such as guidance and flight control, Honeywell is also involved in more prosaic but equally important fields of Human Factors—such as layout, environmental controls, tool preservation and growth, high temperatures, acceleration and other factors—which cannot space flight, as presently envisioned, without impossible.

PROVEN past performance backs up Honeywell's progress in the new fields of missiles and space The Aero Division has produced 45,000 autopilots, 150,000 engine turbo-regulator controls and 360,000 gyros. Honeywell designed and manufactured the first practical electronic fuel measurement system and is now the major supplier. In addition, the company produced the first flight control system designed for supersonic aircraft, and years ago mastered techniques necessary for mass-producing a complete line of hermetically integrating gyroscopes which are the most accurate in the world. Honeywell not only makes the smallest fine-tilt gyro, but also the smallest conventional gyro, the Golden Gyro, which weighs only three ounces.

Lockheed's Hercules takes U.S. based troops Any place on Earth in 1½ days

The Jet Age's first strategic/tactical transport, the new Lockheed C-130B HERCULES, is the only U. S. Air Force plane designed specifically to airlift battle-ready troops, equipment, and supplies from the U. S. to any area on earth in 36 hours or less—then paratroop them into battle areas or land with them on short, rough fields, sand, snow or ice.

The C-130B HERCULES is a bigger, more powerful, longer range version of the C-130A HERCULES—which in two years of world-wide service with the Air Force has become the unchallenged Champion of the U. S. Strategic Airlift.

Now coming off production lines at Lockheed's Georgia Division, the new C-130B HERCULES will soon enter service with the U. S. Air Force's Tactical Air Command.



Takes off from steep sand overnight only 1300 feet on a C130A at 110,000 pounds gross weight. With same load it landed on sand and stopped in less than 900 feet.



Landing on frozen lake, "Skid-130" (towing 42 tons gross) stops in 1300 feet. Taking off from same lake, that skid-flared Airlift Champion was airborne in 2100 feet.



20 tons of pallet-loaded cargo can be loaded in or out of the C-130 in 40 seconds. Hercules can land, unload 20 tons, allow 20 tons take off in 30 minutes—saving 215 hours.



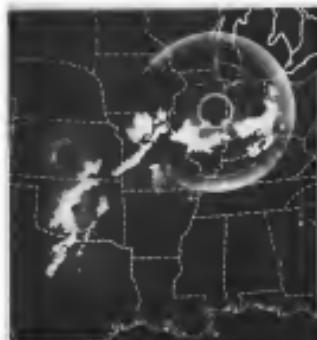
The C-130 HERCULES transports 92 battle-ready troops, or 54 fully-equipped paratroops—and holds the world record for the heaviest paratrooper-extracted drop, 20,370 pounds.

Challenging opportunities available today for aircraft and nuclear engineers and scientists. Write: Professional Employment, AM West Personnel Service, N. W., Atlanta 8, Georgia.

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AIR TRANSPORT • AIR FIGHTERS • AIR TRAINERS • COMMERCIAL & MILITARY PROP-JET TRANSPORTS • ROCKETRY
BALLISTIC MISSILE RESEARCH & DEVELOPMENT • WEAPONS SYSTEMS MANAGEMENT • ANTI-SUBMARINE PATROL AIRCRAFT
NUCLEAR-Powered FLIGHT • ADVANCED ELECTRONICS • AIRBORNE EARLY WARNING AIRCRAFT • AIRPORT MANAGEMENT
NUCLEAR REACTOR DESIGN & DEVELOPMENT • ENGINE SUPPORT EQUIPMENT • WORLD-WIDE AIRCRAFT MAINTENANCE

AVIONICS



ADVANTAGE of composite radar weather possibility (SWP) can be seen. In comparison with the conventional weather display for the same time and region, strengths of different types of weather are distinguished here. Large bright areas show into the Great Lakes and the Great Lakes region. Below shows this in a series of equal times at different stages of development, with an aid directing system oriented east and west. Thus, the two other equal SWP systems shown, compared with the complex analysis are clearly at the distance front analysis. The radar picture also shows that some scattered thunderstorms are reported later on.

U.S. Planning Nationwide Weather Radar

By James A. Fuss

Radar has found a new and important use in the rapidly growing field of solar meteorology. The technique is simple and sufficiently promising for acting faster and more accurate weather forecasting to the Air Force and Weather Bureau. It is now feasible planning the installation of a nationwide network of weather radars and automatic data processing equipment to produce "interred" weather maps over the entire U.S. The system is expected to be in operation within the next 10 years.

Radars' Values

The value of radars in weather forecasting is that it provides a short-dimensional view of the atmosphere in discrete areas of interest, providing related weather events. By analyzing composite information from a number of radars, large scale weather phenomena such as winter fronts can be viewed and their movement accurately followed.

Radar weather observation will not make obsolete more conventional meteorological instruments such as the anemometer, barometer, and thermometer, but will supplement them in preparing

use of forecasts. One important use with both civil and military applications is the extremely rapid presentation of storm areas for routing of high-speed jet aircraft.

Joint Project

To meet the modernization program designed to integrate existing and proposed weather facilities, a three-way agreement has been reached between the Department of Commerce for the Weather Bureau, Department of Defense, for the Air Force and the Federal Aviation Agency, that will result both in a national and a global weather system.

The program will be under Air Force direction and is designated by the Air Force as the WS 431L weather system. Air Force part of the system will consist of the WS 431L Long Range Weather Surveillance Radar system and WS 430L global communications system. Radars for the WS 431L system will be completed within the next two months, and the contract batch by the time the system is completed early next year 1960 without

Plan for the WS 431L system was evaluated by scientists at the Air Force Cambridge Research Center to determine and expand present methods of fore-

casting weather information to meet demands for jet aircraft and missiles that require weather data presented by radar rapidly so they can be cleared at proper altitude. Additionally, the usefulness of weather observations that must be provided in forecasting of a rapid rate.

One of the early phases of the WS 431L program will consist of setting up a test network of nine stations extending from Boston, Mass., to Norfolk, Va. These stations, located at Air Force, Navy, and civilian airports and seaports, will provide as East Coast test sites where equipment and techniques will be checked in operation as they are developed.

Observations from all nine stations will be sent to a "weather center" where composite (large area) weather maps will be prepared at intervals as short as an hour apart. The weather control will be the supervisor of a national weather control that will interface with the completed national weather system.

System Development

Radar meteorology as a field of scientific study is comparatively young, dating back to World War II when mea-



TWO METHODS of combining radar weather observations with surface synoptic analysis are shown above. Frontline sketch shows a plotted and analyzed surface chart upon which the radar plus portion indicates echoes have been superimposed to the location of precipitation echoes as shown with respect to the frontal system. In the presentation of right there are no equal weather observations included, but the nature of the precipitation echoes is obtained from a series of observations shown by means of various placed at the proper position. Direction and speed of elements of the main system are shown.



Network

more radar data detected echoes from precipitating clouds. Since then, a wide variety of tropospheric phenomena has been identified in radar displays—precipitation, echoes from lightning flashes, birds, trees, and freezing rain.

Phenomenon of Echoes

More recently, the interesting phenomenon of echoes received from direct air has been identified and studied. Some of these echoes appear to be produced by masses of birds and insects, but the majority are believed to be associated with snowflakes or ice crystals as they fall through air containing a wind shift, ice front, and thermals.

At present, inter weather stations of the Weather Bureau, Air Force and Navy are used primarily for local operations and forecasts. Weather reports are sent by teletype to other regions via tape, but no provision exists at this time for assembling and plotting novel features of weather from widely spaced stations.

Complete radar coverage of the U.S.—except for some service installations—is not intended initially—but will require an estimated 100 stations. A theory was worked out to indicate how strong the gradient would have to be

completing installation of 38 AN/FPS-4 weather radars, and the Weather Bureau has purchased about 16 WSR-57 weather radars scheduled for delivery in 1959-60. About five similar radars will be delivered to the Navy.

Presently all plans of radar installations are being made, and a pattern of what is called a minimum density plan pattern indicating display. In this presentation, the radar sites at different elevation angles and sections of the coast are assembled to show, for example, much denser between 6,000 and 11,000 ft or at the 10,000 ft level. To do this, radar data must be stored for two to three minutes before being recorded in a single display. At the mid-range under a certain angle, there is a very sparse rate of stations, either far and fast photographic

or Standard Research Institute. Research

for a given wavelength. Early research also has been conducted on the steering and classification of storms.

•McGraw-Hill Book Company has published both theoretical and more practical and descriptive material of what is called a minimum density plan pattern indicating display. In this presentation, the radar sites at different elevation angles and sections of the coast are assembled to show, for example, much denser between 6,000 and 11,000 ft or at the 10,000 ft level. To do this, radar data must be stored for two to three minutes before being recorded in a single display. At the mid-range under a certain angle, there is a very sparse rate of stations, either far and fast photographic

Reprints Available

Reprints of Aviation Week's series on satellite communications optics will be available in approximately one month. Copies will be listed at the following rates:

- 10 copies, 40 cents each.
- 11,120 copies, 10 cents each.
- Over 100 copies, 20 cents each.

Copies should be addressed to Aviation Week, 150 West 41st St., New York, N.Y.



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This, with squared-up hysteresis curves, makes Amplex Instrumentation Tape ideal for all recording systems—direct, FM/RCA, PDR, and RIEEPI.

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ture is material about the uses of composite radar pictures. Working with a complete Elm Elec. the work will aim to develop techniques and analysis of terrain picture analysis and suggesting ways in which the computers can be so directed by themselves or computers.

• Team A & M. One of the projects underway is a study of change and read out of radar information. A second is concerned with identification of severe storms by radar. One of the approaches being tried is storage and readout is reconstruction of a single radar PPI picture on a television type display so that it can be moved conveniently in bright light. An elaboration of this system uses plus other means, so that radar pictures taken 10 miles apart are printed with different color prints thereby presenting a display that indicates both motion and intensity.

• Often. Two specialized but otherwise similar radar studies in progress are at the University of Miami, exploring baroclinic generation, and the Illinois State Water Survey, measuring runoff and other hydro-logic phenomena.

Computer Weather Maps

As part of the development of radar meteorology, researchers have developed composite map maps, showing moving weather cells over hundreds of thousands of square miles. These composite photographs are assembled from photo-

s of simultaneously expand patterns of radar plus position indicators showing the location of the storm over the U.S. As a result, meteorologists have found that conventional synoptic weather analysis often fails to provide an accurate and comprehensive picture of the weather. Conventional synoptic maps are prepared on a synoptic basis every six hours. Local stations prepare their own analysis every three hours.

Radar displays, however, are continuous and provide the forecaster with much of the information of maximum interest, how of forecasts, and location of severe storms, storm velocity, mean height, and vertical extent, independent of the time. These first trials of composite radar weather maps have demonstrated the value of the technique and encourage the proposal for a national weather radar network.

A major problem in the storage of data from a nationwide network occurs if it must be acquired simultaneously across the country. It is not feasible for all stations to transmit their information to the weather center simultaneously, probably it will be sent sequentially. Another problem is bandwidth—the maximum amount of information must be transmitted in the shortest possible time.

There is much information in a radar picture that there would not be time to

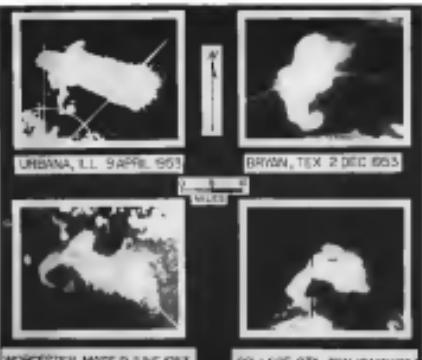
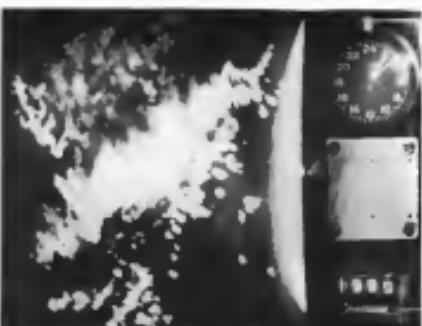


FIGURE 4. Examples of radar precipitation echoes measured with radars, reinforced by visual observations, taken during 1953-54. Two storms, in Bryan and College Station, Tex., were very small, only slightly more than dust cloud clouds. Two tornadoes at Urbana, Ill., and Worcester, Mass., were severe. Block of the echo is the distinctive feature relied upon in the possible tornado threat indicator for warning in advance.

AVIATION WEEK, March 2, 1959



LIGHTNING discharge with indicated length of over 100 m. is shown on weather radar display. Radar echo from the discharge appears as branching structure in the upper left part of the scope, extending from the body of the storm toward the north. The discharge took place possibly at 26,000-30,000 ft above the ground, and buried through clouds of snow and ice following the main initial freezing rain.

FAA Orders Radar Landing Systems

Washington—Griffiss Aviation Inc., Los Angeles, has been selected by Federal Aviation Agency to provide a series of ground-based radar systems for evaluating landing system performance with automatic landing. The system, scheduled for delivery late this year, will be installed at National Air Traffic Information Experimental Center (NAFEC) in Atlantic City, N.J.

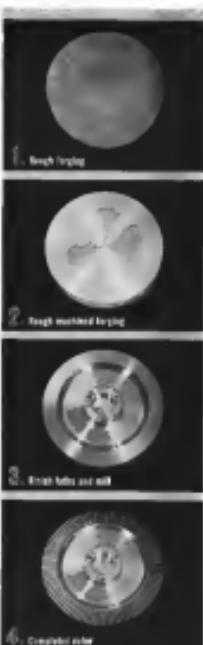
The Griffiss system, whose development was originally sponsored by Air Force, offers several attractive features:

- Flexible glide slope. Unlike ILS the new Griffiss system provides continuously infinite numbers of different possible approach angles, making it easier for handling a wide variety of aircraft types including helicopters.

- Direct cockpit data. Lights right and in the cockpit can provide the pilot with solid closed indication of his aircraft and elevation position as well as distance from the runway.

- Automatic flight control. Cockpit derived signals can tell the autopilot to provide automatic approach and possibly landing if desired.

- Under the \$500,000 contract award by FAA's National Air Traffic Control and Development, Griffiss will supply experimental equipment providing cockpit elevation position and distance. Equipment will be used to evaluate feasibility of the Griffiss approach.



PRODUCTABILITY

New, highly-advanced techniques developed by Houston Forrests make possible savings in time, labor, and cost of production methods of certain aircraft parts. The new techniques also, such as Doctor Mustang, Edmet, and 700, Research and development work invited Behring divisions for help on specific problems.



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AERONAUTICAL ENGINEERING



Douglas RB-66A brings testbed mission down at Washington, D. C., after 4 hr. 16 min. nonstop flight from Ontario, Calif., using Gen. Electric CJ805-3 turboprop powerplants. Axial striking was not necessary on the 2295 cu. in. prop. output averaged 57.5 mph. Total weight was 70,800 lb., including 30,000 lb. of fuel. Four flights are planned in three sets on Convair 880 jet transports, with retention of sound, weapons and thrust systems. Pilot were R. J. Stoks, General Electric's chief test pilot, and L. W. Davis, B-66 project test pilot.

CJ805-3 Has Rapid Acceleration Rate

By Richard Sweeney

Edwards AFB-General Electric CJ805-3 turbofan engines, which power the Convair B-66 jet transport, effectively demonstrated their capability in Aerospace Week flight evaluations here installed at the Douglas RB-66A which they recently prodded from Ontario, Calif., to Washington, D. C., in 4 hr. 16 min. (AW Jan. 26, p. 47).

Characteristics of the test counterpart of the military [7], as noted by Aerospace Week pilot while flying the Douglas software tested, were highlighted as:

• Accelerating from idle to full power at rates which catch those in the same response category as a piston engine-propeller or the Allison 30HD-13 power package. Response rate is substantially faster than other turbines the pilot has flown in various military and commercial jet aircraft.

• Simple and reliable air start which, in addition to introduction performance within the normal air start envelope, worked satisfactorily at several points well outside the normal envelope.

• Fuel economy which, although few and from uncalibrated gauges, appeared substantially better than other turbines of the same class.

In trying to get an accurate prepos-

ture of engine performance and relate it properly to other powerplants, a number of elementary factors were considered which are summarized here in the order of importance which were observed in flight evaluation, between CJ805-3 and other 10,000 lb. thrust class jet engines.

Turboprops are not supposed to have the same propulsive efficiency at low speeds and altitudes as propfans (fans by bypassing, or fanjets).

Thrust/Weight Ratio

Thrust/weight ratio of testbed, acceleration characteristics of the engine, the surface propulsive system, dimensions all contributed to the overall superiority of the Convair engine over approaches which the RB-66 now is equipped and carried in first flight, not as three engines installed.

Testbed, a first RB-66A built by Douglas Aircraft, was used in USAF Phase II flight test at Edwards and is leased by General Electric for the initially commercial CJ805-3 program, reflect thus.

Besides removal of much testgear gear, the weight was reduced by the CJ805-3 program in two ways—particular two engines, as push designed and built by Convair which are almost identical to earlier configuration to 880 jets; we installed the electrical system was changed to incorporate the General

Electric constant speed drives and alternators which are retained on the 880 (AW Sept. 6, 1957, p. 58). Thus the total integrated powerplants and power electrical system components which will be used on the commercial transport.

The RB-66A is basically a non-instrumented testbed and is intended for flying in a generalized program mode to endurance tests which included aircraft accomplished with electric power packages in Elbiton (AW Oct. 14, 1957, p. 91), and Allison "Operation House."

Testbed, as tested, does not incorporate the Convair Electric model suppressor which the RB-66 now is equipped and carried in first flight, nor are three engines installed.

Two flights were made in the Aerospace Week evaluation program, with the main effort directed toward sawing the CJ805-3 features which have gained violent attention, namely acceleration and air intake, plus fuel consumption, although aerodynamic performance was predicted by the lack of proper instrumentation that was noted earlier.

In the acceleration regime, various throttle displacements, at varying rates, were made at a number of altitudes,



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Convair 580 engine pods are made to those on the Convair 880 turboprop transport. Backup port on top is used for fueling.

especially at high and low altitudes. Additionally, no data were taken through altitudes from 13,000 ft to 41,500 ft.

Additional acceleration examples were obtained in ILS cruise approach rate of Onboard Air Power Rose.

CJ805-2 acceleration in rolloff position showed that it can be virtually instantaneous with rapid throttle application. Roll-off maximum possible full power of a two-shaft, reheat aircraft was stabilized at 97% rpm, roll-in arrested and full power applied after speed is gained.

Thrust Buildup

In adding the last increment of power, thrust buildup was simultaneous with thrust increase. In the fast and second segment climb, 3000 rpm for full 5 sec allowable period was maintained. Takeoff was done under CJ805-2 and CJ805 are designed for water ingestion.

Takeoffs were made with gear down, flaps at approach (60%), and open bodies enclosed, with full flap extended just prior to reaching the nozzle number. Average was at recommended value for existing gross weight. The first approach was made with thrust held above the glide slope until close in, giving a longer distance and faster rate of descent than would normally obtain, while the second approach was held to the proper glide slope angle. In both approaches, aircraft was flown somewhat beyond the usual simulated

ILS rollout conditions, to exertion thrust, deceleration and thrust buildup relationship when power is applied for go-around later in an approach.

Full power was applied from 60% rpm, approximate best power level for RB-66A approach in existing configuration, and acceleration was simultaneous with very rapid throttle movement. Thrust acceleration was fast enough that deceleration did not occur when the aircraft built up too fast for the wheel to come to complete. This allows takeoff, even with speed brakes retracted, even though roll-off is delayed.

A standard airbus sound approach profile was followed, either that a high angle pulpit which could hold fire arms or the standard 30° nose up at light gross weight—in the order of 40,000 lb, which gave a very good thrust weight ratio.

Engine Performance

Engines, performance through both remanufacture and substantiation. The testbed accelerated rapidly from an approach heading on V, plus 10° lat with a high angle of attack, completed duty re-ingestion, giving rise to the opinion that reaction is almost equal to a propeller propulsive moment.

Thrusts were checked, classified and generally severely checked according to seat engine handling standards. No signs of compressor stalls resulted from the sampling, and in both approaches, aircraft was flown somewhat beyond the usual simulated

air starts with CJ805-2 are approximately very simple to these operations—two air fuel, boost pump, air start (igniter) switch and fuel control. No great noise from windmill traffic or off-shore aircraft.

Starts were made in flight conditions above the normal ascent altitude and below normal descent. In all cases the powerplant successfully initiated ignition of winterized fuel and up to 175 rpm was developed for low as 385 ft altitude or speed at motor rating. CJ805 was tested at motor rating for altitude of 61,500 ft in one case.

Single Engine Test

In the normal, altitude could not be maintained on one engine at the average weight of 45,000 lb to 52,000 lb at which several high altitude static tests were accomplished. In this case, after engine had been started and before 30° nose up, the engine fuel stopped at about 25,000 ft and when this altitude was fully accomplished and the engine was returned to the flight power setting.

One motor test was accomplished at 46,000 ft with gear down and engine rated at 90% rpm, or 186 lb IAS (Mach .56), a static low fuel speed for the altitude. Little altitude was lost since the engine was not allowed to drop down to low speeds, a nose cone saving process.

Both engines were delighted at 75,000 ft at 40% of 411 rpm, both at 146 lb IAS (Mach .53), with fuel flow on one viewing to 515 lb/hr., the other to 530



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to hot, and exhaust gas temperature (EGT) held at 490° and 490°.

In about all rate fuel flows at constant idle speeds measured surface plots at around 25% of the 500 lb/hr value and EGT peaks at engine control setting between 490° and 500°, although the majority were at the level of 490° to 495°.

A component of the CJ853-3 which gets much credit for engine's performance area is the Woodward fuel control. Among the features of this control is a capability of the engine to be re-started and re-accelerated at any position from idle to full thrust at any altitude or speed.

Once such start was demonstrated, in which the throttle was left at full open position when the fuel was shut off. The lesson learned showed which would have been incurred if the engine had been allowed to cool completely during the time period required for shutdown down to about 285° rpm, the engine was restarted at about 495° rpm. Redshift was normal and the engine moved to idle rpm of about 615° rpm. Igniter fire was observed when acceleration fuel flow schedule was followed, engine quickly and smoothly moved to 950 rpm which was full throttle value for the altitude. There was no overheat or hunting.

Several similar examples were accomplished by the AirResearch team which used idle rates set at 915 rpm at 15,000 ft. In several such shutdowns, in which engines were allowed to idle down to about 27% rpm at altitudes of 10,000 to 100,000 ft, the EGTs (about 300°), might have approached shutdown. At the lower altitudes and less than maximum power settings, shutdown does not at any time would have occurred at low altitude due to higher temperatures, since turbine air temperature is the base regulated via Contingue.

In the Woodward model, a corrected stall airflow is incorporated which prevents compressor stall and engine surge which might easily be obtained with reverberant throttle bursts and high throttle setting air currents.

Examples of these were done in AirResearch Wind Tunnel evaluation.

With these data, the team could predict, compare and determine the maximum compressor inlet nonuniformity, airgap and throttle position. The unit essentially as an airframe, functioned to steer reducing fuel flow to prevent overshoot and hunting as the open air passes the valve until fuel by the throttle setting. It works in reverse on a throttle drop-preventing stall from sudden fuel starvation conditions.

As in any turboprop, the CJ853 is designed for a certain mass air flow, which is subject to change according to altitude and temperature. To ob-



First Grumman Mohawk Nears Completion

First Grumman Mohawk turboprop Army observation plane is nearly completed on Grumman's production line at Bethpage, N.Y. The Army will spend \$12 million for 15 Mohawks, let follow-on to a contract awarded last April for construction of more prototypes which will be tested and evaluated by Navy Bureau of Aeronautics. Note at advancing Mohawk contracts for the Army. Short takeoff and landing aircraft designed to operate from small unprepared fields, is powered by two Lycoming T53-L5 turboprop engines each rated at 1,000 rpm. Mohawk has recycle heating gas, weighs 9,000 lb empty and has wingspan of 40 ft. Overall length is 41 ft. Armament will be AD-1AF.

tain desired mass air flow, or as close to it as possible, the engine incorporates a corrected engine speed feature, an electronic device to measure the altitude and temperature changes.

The unit works to provide the value of flow which would be at the proper level at the selected rpm (throttle setting) and altitude on a standard day. When temperature is below normal, the actual engine rpm drops since proper rpm must be obtained with less engine speed. On a hot day, actual engine rpm must be greater to make up for the less dense air and still provide the proper or best obtainable mass air flow.

Optimum Mass Flow

Realistic on the pilot's instrument panel is the proper bi-potentiometer used for the altitude and temperature, although actual open air is higher. For example, on a hot day at 37,000 ft, the instrument panel readouts may read 94% rpm while the actual engine speed is 101% rpm, maximum limit speed for the engine. This will give the optimum mass flow, either the value desired or the closest possible for the altitude and temperature.

The CJ853 is a 1979 powerplant, IAW Air. 11, p. 601, the Phase II development stage. However, it has no afterburner, but the engine is shrouded in other areas to keep the engine air passes the engine's structure for longer service periods before enough heat for combustion is reached. One area of difference is that while the D97-3 uses magnesium in part of compressor case, the CJ853 uses a steel case. There is additional structural reinforcement in areas where larger stresses like will mean reduced maintenance cost, where

weight is not the main criterion it is a suitable possibility.

The current CJ853 program got under way in 1976 and is now well into the modification cycle. Scheduled to fly in October of last year, its first flight on the modified testbed was made at 4:30 p.m., Oct. 10. Following 10 quick turns of shutdown, the testbed was delivered to Douglas Apache at Long Beach for static test. It was returned to General Electric in December.

General Electric is funding the Ed 1000 AFB flight program to provide as close a simulation as possible of altitude and temperature. Flight schedules are set after conferrals with airline operators who have purchased the Canadair 900 with CJ853.

While one engine in the ED 1000 is partially instrumented, a fully instrumented CJ853-1 is installed in the Douglas XP-10 which General Electric operates in a testbed. Engineering test data is derived from this aircraft which uses an ultralight and photo panel data gathering system. CJ853-1 first flew April 10, 1980, at Edwards AFB, Calif., and has since been to Canada for ground road and testbed tests. An other CJ853-1 was installed in the XP-10 last September.

In the RB-56A, current engine bypass accumulated quite a few hours. Now, over about 10 hr, an engine will be installed which should have run 1,000 hr on test stand at General Electric plant in Evendale, Ohio. This powerplant will be run another 1,000 hr, it is hoped by October of this year.

Goal of this progress is to mini-

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time between overhauls to 1,800 hr for the engine, if properly below the powerplants onto commercial service. Additionally, it will give General Electric a good idea of the problems to be encountered in design service life of engines once they have passed the first 500 hr in service.

Tested life is to be equipped with the same major gages which will be used on the production 300s, to get an idea of comparability of powerplants and maintenance.

So far the testbed has been flown by General Electric and will pass on the same Avrovia Wema pilot. Don Gernhardt, 580 hr test pilot, flew the 300-bed before the first 300 flight, sampling engine performance, air sharing, static tests and possible compressor stall at altitude.

Conair will be making studies at the General Electric Research facility, two at a time, during the remainder of the program to help to link with the flight and to gain familiarity with the powerplants and electrical system components.

Napier Inaugurates Canadian Subsidiary

London-British aircraft and diesel engine manufacturers D. Napier and Son Ltd., part of the English Electric group of companies, has formed a Canadian subsidiary, D. Napier and Son (Canada) Ltd., to increase trade with Canada.

New subsidiary will sell, distribute and service all Napier aircraft including the "Delta" short range and medium gas turbine, Rolls-Royce Vickers, and Foster Wheeler have formed a new company, Rolls-Royce and Associates, to design and build nuclear power equipment.

At three should be established on the strength of existing contracts.

New subsidiary plans to serve in every field of nuclear power, including nuclear generation of electric power, turbines, reactor engines and the "Spacematic" aircraft refueling system.

Headquarters of the new company is at 4104 St. Catherine St. West, Montreal.

Rolls-Royce holds 51% of the \$700,000 initial capital.

Ministry Airplanes Get Fluorescent Paint

London-Britain's Ministry of Transport and Civil Aviation is putting fluorescent orange markings on its fleet of 15 aircraft and for testing pilots and equipment. It is hoped to persuade airline operators to do likewise, as an aid against radar collisions.

Independent airline Flying City Ltd. has announced it will paint its fleet of 17 aircraft fluorescent "radar red." British Overseas Airways Corp. is also "cautiously optimistic" of using this paint on its fleet.

Jet Plane Facilities Readied at Seattle

Seattle, Wash.—In addition to the administration building at the Seattle-Tacoma International Airport should be ready for use as April, according to George V. Wrenshall, chief engineer for the Port of Seattle, airport operations.

A 300-ft long hangar will provide additional maintenance facilities and gate facilities, with three positions for jet planes and one for piston-engine transports. A 270-ft vehicle parking lot in front of the hangar is designed to relieve congestion in existing lots.

British Companies Form Nuclear Group

London—Three major British companies, Rolls-Royce, Vickers, and Foster Wheeler have formed a new company, Rolls-Royce and Associates, to design and build nuclear power equipment.

At three should be established on the strength of existing contracts.

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MANAGEMENT

Navy Revises Security Plan to Cut Costs

By Philip J. Kline

Washington—Fundamentally new aircraft classification policy has been established by the Navy Bureau of Aircraft in an effort to strip away the tape that has hampered both contractor and customer and added unnecessary costs to defense procurement.

New security classification policy, which has been laid out with about a dozen contractors, will go into effect for all of Boeing's 14,000 employees within the next four years, probably within the next several months.

Bureau of Aircraft security policy agents within the framework of Defense Department Security Requirements Check List (DD Form 274), developed in 1952 in a means of defining defense contractors, what kind of classification should be applied to various pieces of equipment.

Within the framework, Boeing has applied a new "covert-action" philosophy to what should or should not be classified.

The new security classification criteria will result in the downgrading and declassification of some items now assigned contract or in fixed use. However, Boeing expects that the cut will not be a major improvement in the sole guarding of vital military information.

One Bureau of Aircraft spokesman puts it this way: "By classifying the item which we put in the contract as 'classified' but not 'military classified,' we expect to have more respect for real and accurate information and better protection to what needs to be kept secret."

Planned Achievements

In addition, when the new policy is fully implemented, Boeing expects to:

- Give simple posture of security now spent for spatial handling and guarding of equipment, components, drawings and reports when no themselves are not subject to export.

• Provide redesign releases that will enable local Navy plant representatives and contractors to quickly determine the proper security classification for any piece of equipment, hardware or location.

• Simplify subcontractor at defense work, particularly by small business, by eliminating the need for manufacturing non-critical designs and subassemblies in a general classified area with all the attendant constraints.

The basic philosophy behind Boeing's new program is that the object of security classification should be to minimize

hold military information of value to the contractor and that such things as configuration, equipment design, drawings, models and reports should be classified only to serve that purpose. Specifically, Boeing says, "the classification of technical publications, in some cases, may not be required to defense procurement."

For example, in the past when a contract was placed for development of a new fighter, the entire equipment and its elements usually were classified despite the fact that many of its components, parts might be commercially available on an unclassified basis and some of its techniques might be well known.

From the manufacturer's viewpoint, what he wants to know is what role he is to play in it as an operating program, its ability to supply change frequencies, its plane matching techniques and its vulnerability to electronic countermeasures. This is the type of information that the bureau proposes to classify—not the dimensions of the box the radio antenna is housed in or the length of the threads of the bolts in the antenna pedestal.

Classification Criteria

Instead of maintaining a contractor through drawings of top secret, it is proposed that all design drawings be classified "confidential" as soon as the part, such as new fuel tanks, has its own individual classification, including "unclassified" depending upon whether or not it reveals military performance or operating characteristics of value to an enemy.

Boeing has added a fifth page to the standard DD Form 274 security check list on which it lists 20 different types of significant security notifications, reporting changes in security status, and the like, of which can be applicable to any specific contract. For each of these types, Boeing assigns a classification ranging from "top secret" to "unclassified."

Types of information which apply primarily to aircraft and missiles include on-station time, speed limits and restrictions, aircraft location, cargo loadouts, maximum weight, minimum weight and so forth. For peace-plant programs, categories include specific thrust, specific fuel economy, etc.

Types of information listed for avionics equipment include effectiveness of countermeasures, vulnerability to noise, jamming, microwave depth above or below water for submarine operation, sensitivity, speed of computation, including specific frequency, bandwidth, frequency range, processing capability. Transistor level is technology application. Other specific language can be applied to an aircraft or weapon system.

Bureau of Aircraft has formulated uniform criteria for establishing what classifications should be applied to each type of supplier, missile, helicopter and avionic equipment, depending upon the particular stage in its life cycle and its development through form fit and design classification.

Typical Applications

Using the previous example of a search radar, here the general frequency band is X-band, X-band, the L-band, the C-band, the specific operating frequency within that band would be divided "confidential" during development and operational model fabrication. But when the equipment goes for flight testing, the general frequency band becomes unclassified, but the specific frequency within that band remains "confidential." This is a practical viewpoint inasmuch as the size of radar equipment may be as much as ten men positioned during flight tests, avoid the frequency band but not the specific operating frequency on that basis.

For example, for example, that drawing produced when some classifications apply, the radar is manufactured and used during the drawings, specifications and so equipment for warships when their size, configuration and characteristics do not call for the specific operating frequency, only the general band which is unclassified.

Similarly, the radar display console also might have a general classification for all drawings, standards and test equipment for the warship which are inert after manufacture but the radar usage and anti-countermeasures capability.

As result of this new Boeing policy, most of the components of a new system can be shipped without the elaborate security measures that formerly required a sealed house and/or armed guards.

Applying the new philosophy to a new Navy aircraft, recent tests of the aircraft show that little modification is required. When the aircraft can reach its ceiling, the aircraft configuration was still classified. The contractor therefore requested ap-

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presently 5,000,000 to build a single line to shield the plane from public view. After much discussion, Baker and the contractor found that the only significant feature which needed to be kept secret was the shape of the engine intake. This could be accomplished by building an analysis structure for masking the intake at a cost of a few thousand dollars.

With the new explicit, open definition of what constitutes classified information, Baker expects to produce more of the kinds of requests for interpretation which persons had to come to him before for a decision, as outlined in Paul Krasnow's Radiations in Context in Baker's security director's file classification.

For instance, certain classified equipment must either be placed under 24-hr guard or else removed from an airplane for storage. Recently, the question arose in Asia, a Navy field facility. "When we pull out the equipment, must we also remove all of the airplane wiring which interconnects elements of the equipment?" Under the old policy, the cables might be considered part of the classified equipment. But under the new security policy, they are not considered classified, whether the cables could be themselves most specifically useful information about the classified equipment.

Airline Back-Breaker

Instead of applying the new philosophy only to new contracts, Baker decided to apply it to existing programs and components as best one. Tough cut of this intricate situation came in Baker's Airlines Division, where some 10,000 components and programs had to be reviewed to make the work available to the public. The process was spearheaded by William Goings, working with Konneker's office. Some of the components had been developed during World War II, still carried a secure classification because no intellectual guitars around. By declassifying them, approximately 7,000 items were declassified, a number of others down graded.

Baker considered reclassification of individual subassemblies and items, areas being examined approached in a series of meetings between his office and the various contractors involved. In one case, two subassemblies with over 100,000 items that would have required detailed study.

Therefore, Baker will establish security classification levels for reference blues and name parts only on future contracts. This will be done concurrently with spare parts procurement. Each contractor will be responsible for recommending security classification for individual spare parts but recommendations will be reviewed by the Baker security director. Goings believes that

the bulk of the spare parts will be an offshoot.

Within the next several months, the bureau expects to publish a new Baker Classification Guide book, which will list every one of its contracts and indicate the new classification category which applies to each. Once even six months each of the classified programs will be reviewed with the appropriate

parties, changes to establish whether they change in the new categories has taken place. It is a new security rating will be listed in the next edition of the Classification Guide which will be published twice a year.

When the first new Classification Guide becomes available in the next several months, Baker will then convert its new policy to all of its contractors.

AIRPORT REQUIREMENTS†

	Air Commerce Airports*	General Aviation Airports*	Total Holes**	Standard Rate Holes Monitoring Site	Administrative Rate Site
All	\$15,001-\$200	4,474,000	\$12,000,000	\$6,402,530	\$1,628,400
Alla	\$201-\$500	3,129,000	72,324,000	7,439,000	1,948,000
Allb	\$501-\$1,000	3,458,000	7,374,000	1,211,000	318,000
Cola	\$1,001-\$2,000	1,181,000	1,181,000	457,000	119,000
Colb	\$2,001-\$5,000	3,786,000	30,189,000	7,541,940	1,904,960
Cola	\$5,001-\$10,000	7,403,000	12,813,000	3,491,480	925,000
Colb	\$10,001-\$20,000	2,083,000	2,083,000	814,000	220,000
All c	\$21,001-\$50,000	2,193,000	17,723,000	5,241,960	1,499,440
Alla	\$50,001-\$100,000	5,710,000	20,481,000	7,946,000	1,998,000
Allb	\$100,001-\$200,000	4,906,000	5,461,000	1,611,000	418,000
Cola	\$201-\$500	4,374,000	10,381,000	2,731,940	725,480
Colb	\$501-\$1,000	4,859,000	4,859,000	1,238,000	320,000
Cola	\$1,001-\$2,000	2,279,000	2,279,000	582,000	145,000
Colb	\$2,001-\$5,000	9,479,000	12,191,000	3,054,000	849,400
All d	\$5,001-\$10,000	2,402,000	2,402,000	621,000	171,000
Alla	\$10,001-\$20,000	8,826,000	9,181,000	2,335,000	620,400
Allb	\$201-\$500	1,824,000	1,824,000	476,000	119,000
Cola	\$501-\$1,000	12,448,000	12,448,000	3,274,000	811,000
Colb	\$1,001-\$2,000	3,244,000	3,244,000	836,000	211,000
All e	\$2,001-\$5,000	1,294,000	9,710,000	2,336,000	620,000
Alla	\$5,001-\$10,000	6,823,000	22,319,000	4,846,000	1,194,000
Allb	\$10,001-\$20,000	6,114,000	15,930,000	4,072,000	1,098,000
Cola	\$201-\$500	15,930,000	15,930,000	4,072,000	1,098,000
Colb	\$501-\$1,000	2,272,000	2,272,000	564,000	143,000
All f	\$1,001-\$2,000	2,174,000	8,800,000	2,024,000	513,000
Alla	\$2,001-\$5,000	2,046,000	12,791,000	2,024,000	513,000
Allb	\$5,001-\$10,000	2,046,000	12,791,000	2,024,000	513,000
All c	\$10,001-\$20,000	2,046,000	12,791,000	2,024,000	513,000
Alla	\$201-\$500	2,046,000	12,791,000	2,024,000	513,000
Allb	\$501-\$1,000	2,046,000	12,791,000	2,024,000	513,000
Cola	\$1,001-\$2,000	2,046,000	12,791,000	2,024,000	513,000
Colb	\$2,001-\$5,000	2,046,000	12,791,000	2,024,000	513,000
All d	\$5,001-\$10,000	2,046,000	12,791,000	2,024,000	513,000
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Esso**JET AGE EXPERIENCE****To serve you now and in the future**

Jetliners in today will make real demands on petroleum suppliers. With fuel requirements increased four-fold by the huge commercial jets, will your supplier be able to provide proper service in the difficult years ahead?

Twelve years ago, Esso pioneered and developed high-speed hydrotreater refining. This speedier and safer method is now available at many major international airports—a practical and efficient solution for the increased fuel capacities of today's large jet-powered aircrafts and

tomorrow's giant jetliners. Esso Aviation Turbine Oils (50 and 55), developed a decade ago, are still the only synthetic lubricants approved for the engines of the world's most advanced turbine carriers.

Your experienced Esso airline representative and technical service man will be glad to show you how Esso has prepared to meet your aircraft's unique fuel and lubrication requirements. No matter how complex your problems, Esso can serve you better.

A good sign to fly with...**AVIATION PRODUCTS****EQUIPMENT****Fuel Unit Would Prevent Contamination**

SHELL'S new fuel filter unit, the Fuel Equipment Laboratory Unit, is a full-scale unit that will automatically shut off the pump on a refueling wagon to prevent contaminated fuel from entering sensitive turbine engines.

The unit is designed to detect early enough to prevent fuel contamination from reaching the sensitive turbine engines and causing damage. Low efficiency, but rapidly changing and more common, are the cases where turbine fuel contamination causes premature failure of parts, requiring an unplanned repair and maintenance work. So far, engine manufacturers haven't really been a problem in the U.S., says Shell, because the Rolls-Royce Dart engines which power almost all the turboprop aircraft have an extremely simple design. The introduction of the pure turbine engines, however, is due to change this.

A more immediate objective is the development of a filter separator that will remove contaminant effectively. There is no filtering unit available today, Shell claims, that filters particle size distribution. A good filter can remove 99 percent of the foreign material in turbine aircraft engines, but there are very few filter units that can remove 99 percent of the fuel. They are very small range, say from 1 to 150 microns. What is needed is a filter separator which will take out all foreign materials above, up to 10 microns without slowing the fuel pumping rate. This would be a significant step. Meanwhile, Shell and others are investigating supplemental, positive-cut-off devices.

Until now there have been no specific test set for fuel contamination. Both aviation and military requirements have been based on the government specification for fuel, MIL-F-8310B, which simply measured the removal of a percentage of all contaminants. The specification is presently being rewritten and will probably include particle size limits based on the work now in progress at Aerodell Laboratory.

Shell's interest in the problem stems from its position as an aviation fuel supplier, selling more than 50% of the aviation fuel purchased for commercial use. Legally, as responsible steps when it pumps fuel that meets the specification through tests, Airlines should give preference to those companies that fuel companies are the first to be blessed by the airlines. While Shell has an interest in making fueling equipment, it feels that it is forced to see standards for that equipment to protect the interests of the company.

The problem of turbine fuel contamination is fast assuming major proportions. More than 100 million gallons/year, the demand for aviation turbine fuel by U.S. airlines is expected to jump to about 1,300,000,000 gal./

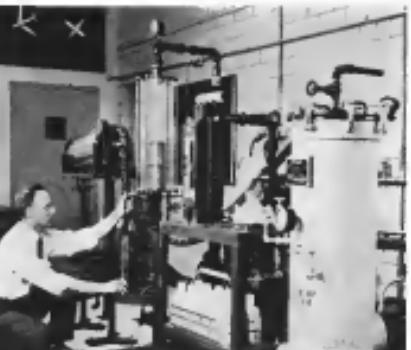
year by 1962. Moreover, there are many facets to the problem. Most important of these are the following:

- Increased availability of turbine engines to aviation and foreign partners. Overman, share have been increasing while total production has lagged somewhat in recent years.
- The introduction of the disk fuel separator, a relatively new device for separating water from fuel, requiring an unplanned repair and maintenance work. So far, engine manufacturers haven't really been a problem in the U.S., says Shell, because the Rolls-Royce Dart engines which power almost all the turboprop aircraft have an extremely simple design. The introduction of the pure turbine engines, however, is due to change this.

- Greater fuel consumption of the turbine engines. Compared to the Douglas DC-3 which burns gasoline at the rate of 150 gal./hr., the Douglas DC-8 and Boeing 707-320 jet transports consume 2,300 gal./hr. of turbine fuel, while the smaller Boeing 707-120 burns about 1,300 gal./hr. That means the chances for fuel requirements to fueling stations are three to four times as great as for piston engines.
- Slower settling out of turbine fuels.

Settling is a current method of filtering fuel contamination and is used, on the average, twice during the course of fuel transit from supplier to aircraft—once is the storage tanks at the supplier's bulk depot and once on the storage tanks at the air terminal. At the same time, fuel handlers try to keep settling time as short as possible, and this is where the higher viscosity of turbine fuel, settling could require additional storage and maintenance which, according to one estimate, averages \$40,000 for a unit of 10,000-gal. tanks. Standard settling time for aviation gasoline is 15 min per foot of storage depth. For aviation kerosene, this will have to be lengthened to one hour/foot of depth to achieve comparable levels.

The solution to most of these problems, Shell believes, is the development of a filter separator which would remove all foreign material and which would also remove some fine dust from turbine fuel without slowing down pumping operations or running into exorbitant costs. Each full-scale evaluation of new filter separators ran at the Aerodell Laboratory costs the company \$5,000 to \$8,000. But although no suitable filter has been developed—nor will Shell produce it when it is in the company's judgment the money well spent.



AERODELL engine pump contaminant fuel through this set to have exterior

HUMAN FACTORS

Human Aspect Specialists Aid Designers

Los Angeles-Shielding rule of the human operator in anti-submarine defense spurs new uses and noble problems of human engineering, hastening the growth of constant front capital of producer safety with specialized support in that field.

One of the largest and perhaps most typical human engineering contributions to Doralay and Aviation at Standard, California, has been recently established in other land in the West Coast missile and aerospace manufacturers.

Human engineering specialists of Doralay have taken part in some stage in development of virtually every current missile system as well as in conception of new aircraft and submarine control systems and in solution of many other problems.

Recent growth of the company and others like it is once evidence that customers are not too sophisticated to be brought by conventional organization along.

The growing importance of consultant operators can be noted in other fields than aerospace engineering. Nearly half of Doralay's work is in systems analysis and operational research, a natural outgrowth of the emphasis in human engineering upon closed loop problems.

Growth Restrictions

Missile and aircraft manufacturers tend to recruit most of their special staffs within their own organizations departments because deep knowledge of a highly specialized subject is seldom needed continuously. A consultant's first call with his service, but it is expected to lay off staff members when their usefulness is temporarily unneeded.

Chief contribution of the human engineering specialist is the job of design, if not more appropriate methods upon engineering problems dealing with man-machine interfaces. Applied and experimental psychologists, which make up the largest part of the Doralay human engineering staff are experienced in laboratory and aerospace research and also had use for the capability. But in many contracts, specialized insight alone is adequate to spot the psychological trouble traps that turn up in weapon system designs.

Doralay holds a contract from U. S. Navy to integrate and monitor human factors aspects of work done by all contractors on the Lockheed Polaris

missiles. Some work is directly by Doralay for companies which lack a human factors capability staff.

A typical problem contemplated on the Polaris was a conflict between the desire of Doralay workers to see the test control officer as a remote person in a remote subsystem and an operator who is the Navy trainee that often starts when he is away.

The Navy position is based on the argument that as an officer is a supervisor and must be free to go quickly whenever it is needed. So the inevitable design compromise was made. All command information is presented at a single point to comply with the Doralay requirements and it is obvious and centrally located to satisfy the Navy requirement.

Control Simplified

Jobs done by ballistic missile for control teams in the operational environment have been made as simple as possible because importance of each step makes operator errors intolerable. Status indicator weapons must start quickly, most work of preparing the ballistic missile for launch is done on a checklist or procedure basis so that it can be started at a moment of convenience if war comes. The role of Doralay and human engineering groups of various missile contractors is to see the operator, if possible, can do his job in the shortest time, in the best manner, and easiest, providing a coherent understanding of data presented and controls.

Ballistic missile launch control centers are considerably responsible for missile safety so that manpower and equipment can be shared among them. The fire control officer at a land-based missile site or on a Polaris submarine has comparatively little to do in the controller unless a malfunction occurs in one of the missiles or supporting systems.

We then want make a complicated decision on how to switch missiles from one target to another, how to re-target base-loaded supporting systems and how to alter the sequence in which the missiles are fired. This involves important calculations dealing with target priorities, how to be expanded or launched simultaneously and how to avoid certain difficult types of malfunction.

Doralay now is studying ways of reducing these calculations to standard operating procedures. Difficult, standardized calculations may be given

a probability of error where target priorities are at stake. Possible management of targets will have to be decided at high ordinary and peacetime levels and incorporated in training codes of use. Coding standard procedures that are roughly the same and consider entry training and birthright credibility is not expected to be easy.

Critical Effect

Extreme critical effect of error and lost time cause maximum and most layout impact. Many functions in the controller must be performed in sequence and if a step is missed, interlocks may open to prevent destruction of components. This would mean a new checklist with delays to the firing sequence.

In Polaris, Doralay recommended installation of indicators and controls for the launcher console is a straight-line arrangement paralleling the sequence of events in the checklist. Start of the events are series of actions performed automatically in the equipment. When a light comes on to indicate the completion of the series, the operator pushes a button beneath it to start the next event.

Designers of missile launching complexes have tried to avoid making several mistakes dependent on the same piece of equipment. If it fails, it is not a major component, and space keeps this type of trouble power to give each missile a complete individual support system. Since this is not possible, they duplicate some equipment and then share it among the missiles. A schematic arrangement of failure indication and system selector switches on the console gives the fire control officer the most available protection of his instructions, setting position and his alternatives in the operation of the human factor experts.

Screenwriters, ballistic missile check-out gear must also check itself where possible. The problem of determining whether a glowing light indicates the loss of component in the missile as in the check-out unit itself is a difficult and time consuming one for the human troubleshooter. The fire control officer may know the answer to settings, controls. To free the crew of settings, controls, Doralay experts have advised that trouble indicators be linked to standard symbolic symbols rather than systems of modules.

It is inside a shield down unmercifully become of a book that is really in check-

out that, the controller must be installed at the beginning and involve considerable time spent in some type of gun stabilization, etc. Doralay are trying to reduce the frequency of checks and tests during the long period of continuous periodic maintenance because operation of components increases the likelihood of failure.

In some early models it was found that components with a life expectancy of 90 operating hours were subjected to much more than 100 hr of test in a relatively short time span. Experience indicates that the reliability of components may have after last shot not as it is after 10,000 shots. Doralay support system studies in training device with a computer simulating the missile.

Guidance Systems

In Polaris, data is continuously drawn from the subsystem navigation system, processed and fed into the missile guidance system. A feedback loop insures that the missile is accepting the correct program. A discrepancy between input and output signals is attributed to position errors. The loop is loosely controlled by a timer circuit to make only corrective servo possible.

Doralay has tried to avoid the use of a human controller where required to switch for a rate occurrence over a long period of time. He believes easily disturbed and unreliable. He is more effective if given some aligned arrows to perform reasonably frequently. In some cases of this type it is better to let the user perform the operation with the machine acting as monitor.

An interesting performance and design environment of weapon systems has been developed around the nature of man to control them; there has been a tendency to integrate non-human sensor, evaluating computers and non-intelligent control surfaces between man and his problem. This human engineering solution has met new human engineering problems by arranging the operator's role to that of documenting the less intelligent human activity. The progressive removal of the operator from the situation by a computer confirms the diagnosis. Human engineers cooperate with the team of designers the operator in accurate and complete symbolic representation of the real world and a way of examining the effect of his actions upon the tactical situation.

The task is an important one, for decisions depend upon perception. Use of increasingly refined models may limit the operator's intuition, in the opinion of Doralay's experts. Much of their work in the field of realistic symbolic display of information has been incorporated in the Douglas-Bell administered ANTP (Army-Navy Instrumentation En-

gineering) programs and helicopter water level panel development study. They have had some success in solving problems dealing with nuclear control systems for submarine and surface search lines of sight.

Navy officials have given a Douglas study much credit for development of omnibus type controls used at the USSR Albatross high speed experimental submarine and scheduled for use in Polaris-carrying role. The technique was put to trials stricken in Project THERMEL, a system test and investigation of ground human computers and related research on subsystems and methods selected for the program. Analysis of performance of 57 operators in a range of 100 different tasks and a paper subsystem showed that in 61 they had some evidence of human error. The most serious of these were attributed mainly to misinterpretation of damage, poor training and ambiguous operations procedures.

Project THERMEL was aimed to assist in design of Albatross controls because access problem of depth control was expected to become acute due to the sub's high speed. Its designers concluded that the depth control would be needed to assist the problem.

Control of a conventional submarine requires three positions: a helmsman, bow planeaux and stern planeaux. Planeaux are responsible for overall depth, rate of depth change, pitch and yaw of pitch change. The operator calls for an overall degree of trim work which cannot always be automated. At times, one planeaux is given the job of conducting depth control and the other is of controlling pitch angle.

Either job is difficult, but displacement of a diving plane control does not cause a displacement of the other two planes. The problem of automation, therefore, is to combine the two planes into one. Doralay's design of the control system insures about portion of the plane. He need insure the plane angle sufficient to prevent any inadvertent control and want select a plane angle to give a rate of depth change proportional to the depth error.

The man-computer technique first employed in Albatross was an airplane type role in which displacement of the control results in displacement of the rudder and planes rather than rates of displacement.

WHAT'S NEW

Telling the Market

Data, charts, and pictures of Avco Thermoelectric, Bulletin 3.8A, Avco Research Institute Co., 135 North Andover St., Chelmsford, Mass. . . Details on blank units, thermal units, dimensions and approximate shipping weights of die cast cap units, specification

charts, Giese Rapporium Corp., 400 Bedford Ave., New Rochelle, N. Y. . . Service Equipment, data sheet, Lockheed, describes a new system concept for the evaluation and screening of jet engines, Avco, Waltham, Mass. . . Pratt Fawcett Division, Borg-Warner Corp., Bedford, Ohio.

Rotating With Pb-Shm, booklet, given circulation and revised data for aircraft and aerospace, Pb-Shm Knit Tool Co., P. O. Box 455, Airport Station, Los Angeles 45, Calif. . . Description of the line of Case-Lite aluminum anodized aircraft and mobile aircraft equipment, Goring A. S. the Sheet Co., 5251 Harrison Blvd., El Segundo, Calif. . . Electronic Catalog Sheet #3010-1A, great material on Retox Proprietary Gas for cooling electronic gas in aircraft and missiles, Retox Manufacturing Co., Inc., Schenectady Lane, Woodstock, N. Y.

Exoskeleton, illustrated brochure on hollow glass exoskeleton for use as a detector material in welding capsules, solenoids, heat barriers, etc., Exoskeleton Co., Channing, Inc., 569 Washington St., Clinton Hill, Clinton, Mass. . . Characteristics of the new generation of solid bellows for control, control and instrumentation fields, Farnsworth Technical Branch, Radioplane Thermostatic Devices, Robertshaw-Farnsworth Control Co., 155 Hill St., Milford, Conn.

Engineering Guide to Silicon Fields for Mechanical Applications, Booklet 111, DenCorporation, Midland, Mich. . . Description, features and applications on Micro Test and Support Equipment, George L. Novak, Jr., 1100 E. 3rd St., Indianapolis 4, Ind. . . 27, Mich. . . Leader of a New Frontier, booklet, gives brief facts for economists and entrepreneurs products and market knowledge, Defense Project FW-117, The Project Co., Inc., 3635 Broadway, Buffalo 13, N. Y.

Illustrated booklet outlines structural static and dynamic testing, experimental stress analysis, hydrostatic and pneumatic test methods, solid-state components in the Ithaca, Cornell Electron Co., Micro and Optics Divisions, Directorate Room 200, 1195 Chestnut St., Philadelphia 4, Pa. . . New general catalog describes company's standard line of quick-connect, quick-disconnect, coupling, Snap-Tite, Inc., Union City, Pa.

Operating principles, installation diagrams, dimensions and adjustment can be found in Model 65 Vitekwinch Multisensor Detector, Bulletin 3F-56, Arrowhead and Instrument Division, Robertshaw-Farnsworth Controls Co., Bedford Ave., Santa Ana Freeway, Anaheim, Calif.

PRODUCTION

Steel Honeycomb Brazed Continuously

By Craig Lewis

Dolles—An automated continuous process for brazing stainless steel honeycomb panels has been developed by Temco Aircraft Corp., and Temco believes on it will do the job cheaper, quicker and better than present manual brazing techniques.

With the Temco-brazing process, panels are heated as they move through a Temco-designed furnace at a regulated rate, then are stretch-brazed to the desired temperature. The furnace and its feed system are flexible enough to handle panels of nearly any practical thickness and length in width.

Development of new processes for

fabricating stainless steel honeycomb panels is significant in view of increasing speeds and temperatures experienced by aircraft of the North American Mach 3 YF-17D and F-108 type and the emerging need for materials to withstand these conditions. Temco has the potential to produce parts of required aircraft size, but says not that the new system was developed for the two company prime or subcontract work.

The new process is designed to replace present batch techniques in which panels are made with either refresher heating and require several hours in a furnace to complete the brazing process. Temco claims dramatic large increases, costless brazing and the use of large quantities of inert gas, and the unique methods that Temco is using to check the panel's physical properties as part of the brazing operation.

It is the latter that the entire brazing method, and is expected to produce a better product because of fewer rejects, according to project engineer A. W. Graves.

Prototype System

Prototype Temco system is designed around a strip furnace with two bands of radiant gas infrared burners. The main opening is 4 ft. wide and 15 in. deep. It is set in the middle of a table of rollers which move the sheet along the side of the table, used to move the panel through the furnace, heating it at a given speed.

To reach them for the process, panels, honeycomb cores and braising allow are put together and covered with a carbon stainless steel end cap which is then welded. The envelope is purged with argon, then evacuated, and a partial vacuum of 5 mic. is maintained throughout the process with the internal argon atmosphere. Pressure of the evacuated envelope has the effect of holding the panel components together.

Panel is charged in a frame that moves it over the roller table and through the furnace. It moves at three to five inches a minute, and speed of the drive drive is controlled by a thermocouple which reads signals to a transistored controller recorder and can take a variable speed motor.

Speed is varied to maintain an even temperature on the panel and prevent warping.

Front burners preheat the panel to about 1,700°, then the second row of burners heats it to the brazing temperature of 2,700°. Preheating tem-

perature and reheat are working on increments. A change in instruments on the preheat section will add those more thermostatic, and these will be used to raise and lower the burner temperature to maintain a constant even temperature. When the molten insulation is preheated, panel will proceed by heat through the furnace at a constant speed.

Porous Welds

Temco has developed a technique for brazing aluminum/honeycomb stainless steel such as 303/300/303, 1915/1700 and 17-7PH, but it can also be used for titanium and other such metals. Panel width is

not limited to four feet because that is the width of the furnace, but wider panels can easily be accommodated in a production version by widening the furnace. There is no limit to panel length except the practical limitations of the furnace itself, which is limited to the furnace.

Using induction heating, Temco has also developed a method for brazing titanium to panel and for joining them to structure. For different positions, punch and die and a cup is inserted so that between can be inserted each track in the panel without causing the honeycomb structure, using an in-tandem stretching hold.

Machine Spins, Roll-Forges Metals

32 Seconds, Cold—Conditioned advantages of metal spinning and roll-forming are being used in a machine developed by Temco. Spin Form 1000 is rated Spin 1,000 rpm, 450,000 lb. torque, 550,000 and will form work up to 6 in. thick and 60 in. in diameter, while reducing wall thicknesses up to one-half in a single operation.

The machine offers up-to-date potential in the manufacture of large-size parts for advanced aircraft and space designs. Designed and built by Hibbitt Corp., a division of the Siegert Corp., in Milwaukee Aircraft Co. and Aircraft Industries Avion specifications, the machine is financed by the Air Force's Air Materiel Command. Spin Form will be used at Marquardt's Digital Units, major manufacturer of aircraft avionics.

Advantages of Spin Form are:

- Ability to produce shapes of revolution such as cylinder cans, venturi and paraboloids or combinations of these.
- Reduction of wall thickness in the forming operation.
- Reduction of up to ± 0.001 in. in wall thickness and diameter for parts up to 6 in. in diameter.
- Advantages of machined-like surfaces on finished parts.
- Increases in tensile strength of part, while eliminating rivets.
- Formation of shapes of irregular surfaces with solid forms.

Mackie's Ability

During a demonstration, Spin Form shaped a 60-in. disk of 32S stainless steel, 3 in. thick, into an inverted mushroom shape, while decreasing the metal wall thickness by one-half. Total operating time took 75 min. Particular shape was chosen to prove machine's ability as part of Hibbitt's demonstration to Macmillan.

It was explained by Hibbitt engineers that the metal was not being heated to shape over the mandrel, but was being formed by plastic deformation in the heated center.

Spin Form operates thus way:

• Rotating disk with material affixed to it is held in a chuck and rotated by hand. Key stock then is placed on the mandrel. This eliminates need for special handling techniques, since ordinary cranes can be used.

• Disk/burner passes down on work with a force of 200,000 lb. Burnback can also exert a pull of 100,000 lb. on work.

• Burner rotates at a speed which is distance variable from 16 to 400 rpm. The disk is driven by hydrostatic motor and has a governing feature which will keep surface speed constant regardless of diameter or rotation.

• Spindle turns on mandrel and work rotates clockwise to hydrostatic drive for the rollers. The rollers can exert up to 775,000 lb. on either a vertical or horizontal plane. Measures

feedback information is returned to the system through the electro-hydraulic system and resistive current collector system. The strength for the class tolerance desired for the finished product.

Electrical Heating

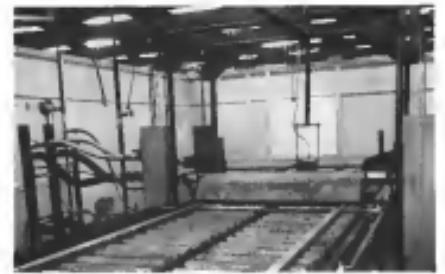
Electrical heating processes are prevalent in flat nests which cannot be cold-formed but be worked at elevated temperatures.

Prevention is being made to install closed-circuit television cameras for viewing the nests, so that the operator need not move from the control panel. This also minimizes noise & the power losses involved, but no electrical drive. Due to extreme pressure, flat nests can only be made explosive de-energized.

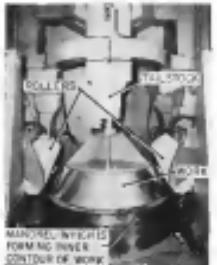
Tableback practice is reduced, down



STAINLESS STEEL honeycomb panel passed in its envelope and clamped in a shaft-driven frame moves through the furnace at Temco Aircraft Corp. The unique programmed envelope of the furnace regulates panel speed to keep burns to a minimum. Low pressure from the panel envelope is used to maintain a panel tension of 3 psi on the enveloped witness signs throughout. Pressure of enclosed envelope keeps parts together.



BURNERS while de-brazing are under the hood of Temco's prototype furnace.



FINISHED pierce shows machined life-size, hollow, capable of withstanding 100% of these, are in other sizes. Piercings are composed of stainless steel.



STRAIGHT forming straight portion of piercings is accomplished by electrohydraulic means to the rollers.

and punch) are moved out from the machine, and a new pierc is machined by electrohydraulic means to the rollers.

One of the most difficult engineering problems in the development of the machine was the design of the hydraulic actuators for the rollers. Halsted originally sought help from manufacturer of hydraulic valves. No one seemed willing to tackle the problem of developing valves to handle the 72,000 psi to actuate pressure and a 3,000-psi spurt.

Halsted solved the problem by designing variable volume pumps and eliminating the need for valves.

Metal Experiments

Experimentation in the working of various metals is still going on at the plant, including the investigation of what can be done with "exotic" metals.

As an example of what the Span Flange will do, a conventional 1100 aluminum alloy, in a 65% reduction, emerged with an increase of 60% in yield strength while tensile elongation decreased from 33 to 3%.

Titanium also can be precisioned on Span Flange according to Marguerat. Similarly, 1020 (100,000 psi yield strength) and Ti-Al-2 (800-1400 psi) titanium alloys were investigated, and while all tests were conducted at elevated temperatures (500-1400°F), calculations show that the commercially pure titanium can be worked at room temperature. While no increase in tensile or yield strength is gained, in Span Flange titanium, neither is there a loss.

Finally, Halsted is demonstrating the Span Flange for shipment and sale.

Continuous-Path Machine Tool Movements Prerecorded on Tape

Englewood, Colo.—Macro-Puff, a simplified system for robotics tool control that utilizes magnetic tape to store a prerecorded program, was demonstrated here by Macro-Puff, Inc., a subsidiary of Tigo Industries.

Systems costs between \$15,000 and \$35,000. Modules may be purchased in several configurations; some units are offered as modular form.

Recording Tape

Macro-Puff provides a means of recording continuous-path machine tool movements on tape without use of the stored programing equipment. Basic software can be applied to existing machine tools so they can be designed into new machines.

Recording and playback modules are located on top control panel of console. Advantage claimed for Macro-Puff system includes:

- Through motion control necessary for continuous path seek, such as profile and contour milling as well as point-to-point operations such as drilling.
- Greater speeds than manual production methods.
- Accurate locating within .001 in. with full-scale climb recording each cutting operation to ensure accuracy of table position relative to program.
- Fully loaded cursor operating at maximum efficiency on any axis.
- Reduced traverse between cuts with resync feature, either as cutting operation without loss of time between operations.
- Accurate duplication of parts without gear or locating fixtures.
- Reduced soap and aspiration noise and minimal cost.
- Reduced programming time.
- Elimination of specially trained operators.



DEB are produced with Macro-Puff contour table and bank of eight vertical drilling heads.



General Electric J85 Variations

Three models of the General Electric J85 turbojet engine each have a different application. J85-1 is developmental, for Northrop T-38 supersonic jet trainer. Just below it is J85-2, powerplant for McDonnell GAM-72 decoy missile, and at right is J85C, which powers the prototype North American T-39 Sabreliner.

PRODUCTION BRIEFING

Tapp Industries, Inc., of Los Angeles, has announced formation of U.S. Service Corp. New company, a wholly-owned subsidiary, will negotiate agreements of Yogo Manufacturing Co., a division of Uppi Industries.

Setzer Brothers, Inc., Cleveland, Ohio, will furnish the Navy with 30,000 gal of Du-Glo for orange aircraft paint. Included in the 30,000 gal is a clear varnish which masks the fading effects of the sun. High visibility paint is intended to aid in the prevention of midair collisions.

Cleveland AeroSpace Asia, a group formed to bring major aerospace contracts to the Cleveland, Ohio area, has appointed Gleba C. Anderson as group administrator. Anderson, employed by the Cleveland Electric Illuminating Co., will be in charge of the newly formed organization to guide its initial operations.

Standard Radar Equipment Mfg. Co., Champaign, Ill., will produce 125-ft. of steel blast fluting for installations at Kirtland AFB, Fla. Blast flutes, to be placed at various rods such as 60 to 100 ft. lengths, will be in mild sheet steel, 10 ft. high.

SPECO Industries, Inc., Philadelphia, Pa., has acquired Bend Instrument



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ably died from drowning. Further, the lack of extensive medical statistics, together with the general condition of the bodies, suggested that the water impact, at least in some cases, had not affected the cause of death.

Late postmortems were found on 14 bodies, two of these cadavers. One of the recovered bodies, showing a late postmortem, was one of the individuals who was still strapped by their safety belt to a seat.

Although no evidence on the rights of the captain in his power's behalf indicated that their seat belts also were fastened at the

time of impact, similar indications were found on other bodies. The medical examiner further disclosed that none of the bodies had been subjected to fire before or after impact.

As part of the pathologist's examination, a series of tests for toxic material was conducted. Initially these tests indicated elevated levels of carbon monoxide in several of the recovered bodies. This preliminary finding indicated (1) the need for further examination, and (2) that the carbon monoxide could be detected here logic conclusions of carbon monoxide could have

been present in the inhalated portions of the bodies. To accomplish the latter objective a Board investigating group made a detailed study of the Boeing 777 systems to determine possible sources of carbon monoxide which could lead to the generation of carbon monoxide. These were considered with probable vents known in the pattern of airflow throughout the fuselage.

This study disclosed that high levels of carbon monoxide could be generated and distributed throughout the cabin if the fans became in severe use. However, it was impossible to relate the elevation of carbon monoxide found in bodies with the seating arrangement and, consequently, with the source of the carbon monoxide.

Medical tests were conducted from the time of the accident to the present to verify the initial findings relative to carbon monoxide concentration in certain of the bodies. These tests resulted independently by different medical specialists verified the carbon monoxide as found initially but could decide as to the causality of any such finding because of the decompositional state of the bodies. Additional studies are presently being performed which may assist the question regarding reliability of carbon monoxide results in terms of postmortem decomposition rates but as yet that question is unsolved.

Witnesses Recovered

Five recovered eye witnesses were interviewed by a composite team of experts. Of these three had been stopped by impact at 36 and 37 mms past the bows, respectively. Two were estimated wounded, shocked and unconscious, and one of these was still running when he was stopped by impact. The others were full of water and had stopped at 35 and just past the bows. Since the "wrecked" eye was cut and showed no physical damage, it was concluded that it ran for some time before being stopped by water impacting. The remaining witness, who had been stopped at 36 mms, had stopped at 25 mms past the bows and had water inside. This was considered to be the probable cause of stopping. Considering the hydrodynamic integrity of the area of the wash showing 35 mms past the bows and assuming the eye was running, probably three persons were exhibited at 27 mms past the bows. Since the aircraft had reportedly stopped at 31mms and did not report, as ascertained, at 31mms, the base of the mode is concluded to have been 312 mms.

An inspection was made of all company aircraft since records of Nov 9094. This included company aircraft, company maintenance, precipitators, and all extensions. A detailed study of these records, which were adequate and in good order, showed that all airworthiness directives had been complied with and that no known discrepancy as regards the time the aircraft was displayed on the tail number was found. The aircraft, 777, was manufactured by the Boeing Airplane Co. on Aug. 15, 1969. The aircraft as operated on Sept. 18, 1970, and it had been operated in an enroute service since that date. It had been progressively maintained and was currently certified.

Investigation. Maintenance records of the aircraft, 777, were reviewed. All aircraft maintenance records were obtained from the manufacturer's records and were found to be complete, accurate and in accordance with all required air laws.

The aircraft was equipped with four Pratt & Whitney model 446D6 engines.

Propellers installed on these engines were Hamilton Standard model No. 4440-1449, blade diameter 101.82 in., and had incorporated the recently developed speed reverse pitch lock to eliminate uncontrolled engine overspeed. The blades were solid aluminum. All Masts and hub assembly propellers had been overhauled and maintained in accordance with company policy. Previous to the accident, the aircraft's first of flying 877 hrs, the Pacific Alaska Division were examined and revealed that no propeller blade failure had occurred since the adoption of the model propellers. None of the propellers had been previously replaced. Each engine was equipped with a General Electric model C1100 intercoolerpackager. These provided pressurized air for the cabin air circulation system as well as for the engine supercharging.

Load Noise

On Sept. 18, 1970, when N 90944 was en route from San Francisco to San Francisco, the crew heard a loud noise. It was described as similar to dropping the navigation stand on the flight deck. The captain made a check of the aircraft and CDS panels and the forward cargo compartment and heard a sharp crack in the cockpit. The attitude indicators were checked through the aircraft and every thing was found normal. This incident was written up on the flight engineer log. The company Report and an addition report were filed. On Sept. 20, 1970, the aircraft was operated by the company enroute to Honolulu, HI, San Francisco. The aircraft was rechecked by extracting the gear and inspecting a visual check by lower pressure. No damage was observed and a normal landing was made.

For this incident the aircraft was written up as a discrepancy as no damage was found. The following action by a company inspection. Inspection annual and found no damage. Damage annual was issued. At this point no action was taken. Final inspection was conducted on Sept. 27, 1970, by the company inspection who reported all the discrepancies. The statement of aircraft failure was "Inspected lower nose and forward cargo compartment, all systems of normal. Found no damage. Inspected main gear, all systems of normal. Found no damage. Inspected tail gear, all systems of normal. Found no damage. Inspected left and right cargo door. Head band could be removed by dropping forward tail fairing. Nothing abnormal found."

Two "head" bandages had been reported by crew on June 8, 1971, and Oct. 3, 1971, respectively. The first was a headband of the aircraft (N 90944) by an infected mechanism, which was adequate and in good order, showed that all airworthiness directives had been complied with and that no known discrepancy as regards the time the aircraft was displayed on the tail number was found. The aircraft, 777, was manufactured by the Boeing Airplane Co. on Aug. 15, 1969. The aircraft as operated on Sept. 18, 1970, and it had been operated in an enroute service since that date. It had been progressively maintained and was currently certified.

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Rolls-Royce Conway Mounted on 707-420

First Rolls-Royce Conway turbofan engine, rated at 17,000 lb. thrust, is mounted on Boeing 707-420 Intercontinental transport being built by British Overseas Airways Corp. The 707-420 is the first of 14 Intercontinentals ordered by BOAC. Conway engines will be used on 707-420s ordered by Lufthansa, Pan American and KLM Royal Dutch Airlines.

In the aircraft and accordingly "tagged off." The aircraft was then returned to the hangar where it was followed by a team which was appointed entirely to the inspecting and cleaning. In the capture of the flight as completed, The verbal report was accepted by the captain to be his opinion that the aircraft was not fit to be used to conduct a flight and was written as a written report.

N 90944 had made 41 flights during the period Sept. 19 to Nov. 8, 1971. The date of Clipper 944's departure from San Francisco. The plane on this flight was equipped according to normal aircraft, namely, radio equipment, lights, etc. There were no other significant circumstances, which were not made a record of record. Nothing was reported that shed any light on the accident.

Fuel Inspection

The fuel preflight inspection was started on Nov. 8, 1971, and continued until the date of departure, Nov. 8, 1971. All areas required had been checked and signed off by appropriate maintenance personnel.

During the course of the investigation, and as a result of the inspection and the discussion of the source of fire and the absence of living survivors or crew members, an extensive investigation of personal effects and backgrounds of crew, passengers and company ground personnel of the San Francisco base of Pan Am was made by CAA and other government agencies personnel.

An investigation of possible personnel in contact with all personnel who might have been exposed to the aircraft for any reason while the aircraft was on the ground or in air was made by the agency and the manufacturer's vehicles to considerably locate than the usual probability would.

The subjects of inquiries, photographs and interviews were made available to the investigation. It was established that the company's employees, training materials, including directions for lighting and smoke evacuation procedures, new maintenance and all new publications of N 90944 had not completely completed the required training.

It is believed that the investigation has not been completed due to the fact that the aircraft was not available for inspection.

The investigation has been discontinued.



Convertible Jets for VTOL Aircraft

One of two convertible turbine engines to efficiently provide sufficient power for vertical takeoff and conversion, low-weight propellers for forward cruise flight is being studied by General Electric's Flight Propulsion Laboratory Department, Cincinnati, Ohio. Propellers shown, using General Electric's P35 turbines, would not fit on a turbine driving one or more lifting fans for vertical takeoff and landing; for level flight, the turbines would be converted to provide conventional turboprop power. Valves in the drive and engine nacelles would convert the flow. General Electric design study (top) converts a long-range, 60-passenger VTOL aircraft, which consists of a canopy 20 ft wide by 20 ft high, a 50-ft wide, 20-ft high fuselage, and a 20-ft wide, 20-ft high tail section. Another proposed (bottom) depicts a transonic aircraft derivative, assault weighing 13,000 lb., including 600 lb. of electronic equipment. Maximum flight speed at sea level could be 550 hr., cruise below 200 knot, on with two base afterburner. Without base afterburner range would be 700 hr. Two P35 engines would drive a single lift fan fitted in the fuselage behind the cockpit.



Investigations, military services have experienced difficulties in the use of aircraft as mobile command posts or mobile headquarters. The aircraft in the way to the mobile command posts or mobile headquarters vehicles to considerably locate than the usual probability would.

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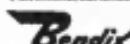
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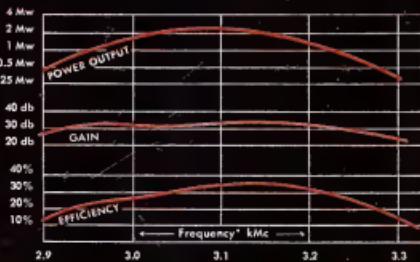


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